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DEPARTMENT OF DEFENCE

PROCEEDINGS

of the

OCCUPATIONAL ANALYSIS SEMINAR

held in

CANBERRA, Sept. 1979

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PROCEEDINGS

OF

AN OCCUPATIONAL ANALYSIS SEMINAR

held at

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~~Canberra Postal Building,~~
~~King's Avenue~~
~~BARTON ACT~~

Canberra, Australia,

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INTRODUCTION

An Occupational Analysis Seminar, sponsored by the Establishments Division, Department of Defence Central Office, was conducted in Canberra from 17-20 September 1979.

Guest speaker was Dr Raymond E. Christal of the United States Air Force Human Resources Laboratory in Texas. Dr Christal was Technical Director of the USAF Occupation and Manpower Research Program.

Members of the Australian Defence Force attended the Seminar in company with representatives from the State Electricity Commission of Victoria, the Public Service Board, the Department of Social Security and the Department of Employment and Youth Affairs.

NOTE CONCERNING DR CHRISTAL'S PAPERS

Dr Christal did not prepare formal papers for the symposium. Rather, he talked from notes and used numerous vugraphs. Presented in these proceedings are key points in each paper which were extracted from the audio recordings of the sessions. Because of the length of the papers, much of the background material and many of the illustrations had to be omitted. This process tended to destroy smoothness in the flow of ideas, but hopefully, it preserved the essence of each presentation.

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OPENING ADDRESS BY

MAJOR GENERAL J.C. HUGHES, DSO MC

CONTROLLER OF ESTABLISHMENTS

Ladies and Gentlemen,

It gives me great pleasure to welcome you all to this Occupational Analysis Seminar, especially those from:

the United States Air Force

the New Zealand Defence Liaison Staff

the Burwood State College

the State Electricity Commission of Victoria

the Committee of Reference for Defence Force Pay

the Public Service Board

the Department of Social Security

the Department of Employment and Youth Affairs

the ACT Curriculum Development Centre, and

the Bruce College of Technical and Further Education

Australia's formal interest in Occupational Analysis commenced in August 1969 when the Principle Administrative Officers' Committee (Personnel) endorsed a paper tabled by the Air Member for Personnel which recommended the introduction of Job Analysis procedures into the Australian Defence Force and the establishment of Job Analysis Sections in each of the three Services and in the Department of Defence.

My interest in Job Analysis, or Occupational Analysis as we now call it, stems from the fact that in early 1975 Defence Central Office responsibilities for Job Evaluation Studies and Occupational Analysis were vested in my Division and a Special Section was established to advise the Service Offices on the implementation of Occupational Analysis techniques and to co-ordinate, as required, Occupational Analysis activities which have Joint-Service implications.

The Aims of the Seminar are, first, to examine the further application of Occupational Analysis techniques to the personnel requirements of the Australian Defence Force; and second, to familiarize Senior Officers with the potential value of the CODAP system as a management tool.

In these days of financial constraints and expensive manpower costs, there is a need to develop and refine techniques for efficient manpower management. Managers are becoming more aware of the need for techniques for gathering reliable information and rapid updating. This implies the existence of a comprehensive Occupational Data Bank. Also there is need for a more systematic approach to problem solving and for computer assistance in the areas of complex problem solving, such as in contingency planning.

This Seminar is the culmination, indeed the high point, of a long period of assistance from the United States. I refer specifically to our guest speaker, Dr Ray Christal and to the United States Air Force exchange officers. Having adopted procedures based on the American experience and having had some experience with practical applications, we now seek to "firm-up" on our future plans and to resolve outstanding problems.

I hope that, as a result of this Seminar, Senior Officers will gain an understanding of the fundamentals of Occupational Analysis, the practice of which, at present, is restricted mainly to more Junior Officers. I hope also that the practitioners will advance their knowledge of the techniques involved and gain the level of expertise which will enable them to further develop procedures. As a result, each of the Services and the Department of Defence as a whole will benefit.

In its explanations of the word "seminar", the Oxford Dictionary includes "conference of specialists" and "short intensive Course of Study". This Seminar is inclined more to the former. Ample time is allowed for discussion of each topic and maximum participation by all is our hope. Let us hear your views.

HISTORY OF JOB SURVEY AND CODAP ANALYSIS SYSTEM

By R.E. Christal, BS, MS, PhD
Technical Director
Occupation and Manpower Research Division
Air Force Human Resources Laboratory,
United States Air Force

INTRODUCTION

1. At the outset, I have to say that my experience has been primarily with the United States Air Force (USAF). The Air Force has a simpler classification structure than the other services. Most of our people are at large bases; and we don't have to worry about the combat arms problem where what you do in peacetime may not be what you do in wartime. For these reasons, I believe that in many ways the Air Force is easier to manage than the other services.

2. So that you will be familiar with the terms I'm using, I'll describe to you the classification structures in the USAF. The first tables are for enlisted airmen. (Tables 1 & 2). There are 48 career fields. In the medical career field, there are 28 career ladders. Within the 48 career fields, there are 334 career ladders. In a career ladder, a person starts at entry level and goes from apprentice to journeyman to first-level supervisor, and finally, to general manager. The skill levels associated with those terms are numbered 1, 3, 5, 7, 9, and 0. There is a grade spread associated with each skill level, and the pay level is directly related with the number of stripes a man wears.

NO	CATEGORY	EXAMPLE
48	Career Fields	Medical (28 Ladders)
334	Career Ladders	Pharmacy
1000+	Specialties	.Pharmacist Specialist (Journeyman)

Table 1. USAF Classification Structure (Enlisted)

GENERAL TITLE	LEVEL	OFFICIAL TITLE	GRADE RANGE
Entry Level	1	Airman Basic	E1
Apprentice	3	Semi-skilled	E1-E3
Journeyman	5	Skilled	E3-E5
1st Line Supervisor	7	Advanced	E5-E7
Superintendent	9	Superintendent	E7-E8
General Manager	0	Chief Enlisted Manager	E9

Table 2. Skill-Level-Grade Relationships

3. The chart for the officers' classification structure shows 22 career areas made up from 46 utilization fields. (Table 3). A pilot is in a utilization field, but a pilot, fighter-interceptor, F106, is in a specialty. The officers' grade levels are divided loosely into three groups: company grade, staff, and commanders and directors (who have most of the higher level managerial positions).

NO	CATEGORY	EXAMPLE
22	Career Areas	Scientific and Engineering
46	Utilization fields	Pilot
598	Specialties	Pilot, Fighter-Interceptor, F106

Table 3. USAF Classification Structure (Officers)

JOB SURVEY TECHNOLOGY

4. Turning to the history of job surveying and CODAP analysis technology, our research began in 1957. Headquarters USAF wanted quantitative information about what people were doing on the job. At first, we were reluctant to accept that responsibility. To us, job analysis was more an area for practitioners than for researchers. Job analysts conducted interviews and time and motion studies -- this was not our forte. We doubted whether research in this area would have any payoff. But now I must admit that managers often have more insight than researchers. The domain was researchable, and the technology coming from this research has had many payoffs.

5. In 1957, the Air Force already had an occupational survey technique. At the local level, individuals wrote job descriptions under supervision. These job descriptions would come in to a central location from all over the world. They came in great quantities and were usually handwritten. The problem was that no one knew what to do with them. One could get a general idea of what was happening in a specialty, but he couldn't count how many people performed a particular work task. People wrote descriptions at different levels of specificity; some wrote broad task statements, and some wrote narrow task statements. They were very difficult to collate. The information was not very useful for trainers; and it didn't help the classification people to determine the occupational categories. The descriptions were most often used to defend actions taken. For example, someone would ask why an occupational category had been broken into two categories. And the answer was: "we analysed this stack of job descriptions!" But, to give the classification structure group credit, it recognized that there was a problem and requested information so that it could do a better job of resolving management problems. It

was at their request that we established our research program.

6. The problem looked formidable. There were 700,000 Air Force personnel performing tens of thousands of different types of work tasks at hundreds of locations throughout the world. How could we find out what all of those people are doing? What a person actually did was dictated by his first-line supervisor. For each job, the only descriptive information we had was a five-digit number indicating the occupation and skill-level. Clearly, we had a communications problem. There just simply wasn't enough information coming back from the field to tell the trainers what kinds of training individuals needed in order to perform their jobs adequately. Well, we studied different systems for collecting occupational data and finally concluded that the task inventory approach was the best. Fortunately, computers were coming on-line, and we thought we could handle very detailed information provided we could collect it.

7. The task inventory which we developed for occupational surveys is a very simple instrument. It contains a Background Information section in which we get general information about the worker and his job. Also, in this section, we collect attitudinal information. We ask incumbents whether their job is interesting. The background information is very important because our ability to address management questions later on is a function of whether we have information to identify subsets of people in which we are interested. I would like to stress the importance of looking at management's needs before sending the inventory into the field. The second part of the inventory is a list of all the tasks performed by anyone in an occupational category. It takes a long time to develop a list but, once you have it, it becomes a very useful instrument. Every person in an occupation should be able to define what he does in terms of a subset of tasks in that basic list.

8. How do we get information directly from workers in the field? Well, first, the incumbent fills out the Background Information section; then he reads all the tasks in the inventory and checks (✓) the ones he performs. Also, he writes in any tasks that he performs that are not in the basic list. Next, he reads through the list again and, using a simple scale, indicates the relative amount of time spent on each task. Now you can see why we selected the inventory approach. You get quantitative data, and you can count how many people do a task at each location. It's a relatively fast procedure in that you get information from people scattered across the nation in a matter of weeks. On the other hand, if you went into the field to interview people, it would take a lot longer to get a substantial sample. The task inventory data is analysed by computer; and you can generate all sorts of reports to service management needs. Finally, the results are subject to research and verification.

CODAP PROGRAMS

9. Occupation surveys using task inventories is only half of the technology. The other half is called CODAP (Comprehensive Occupational Data Analysis Programs). CODAP has five

classes of programs:

Job Description Programs
Job-Typing Programs
Research Programs
Task Factor Programs
Interactive Programs

10. Job Description Programs describe what people are doing. You can get a description of one person's job. It will list every task he does and the time he spends on each task. If you have a group of people at some location who report that their talents are not being utilized, you can print out a description for each person in the group, one at a time. Usually we compute group job descriptions. For example, you might wish to have a job description for women working at a particular job location, or for sailors on a particular class of ship. The computer will produce a job description for any group that can be defined in terms of information collected in the background section of the task inventory. Managers may want to know if there are differences in work being performed by two groups. For example, is there any difference in the work being performed by incumbents in adjacent grade levels? You can ask for a difference description for the people performing their activities in Grade E4 versus Grade E5. You can have difference descriptions for men versus women, for individuals on one ship versus another, and so on. You can also request a group summary which lists the tasks in the inventory by rows, and any other variable by columns. Column headings may be for any breakout, such as for class of ship, aircraft type, or time-in-service. If the columns are constructed in terms of months of service categories, you can read across the task rows and find out when tasks tend to come into play. This is a useful output when you want to find out when training should be given to be timely.

11. Next, we have job-type programs which are very important for decisions concerning the classification structure problems. Job-type programs compare the work being performed by all individuals in a sample. They pull together people doing the same tasks, and define the types of jobs which exist in an occupation. For example, job-type analyses revealed there are over 20 distinct types of jobs in the Air Force's Materiel Facilities career ladder, even though we act as though it is a single occupation. This sort of information is very important when you are considering changes needed in your occupational categories.

12. Research programs are used to address many management questions. Take the variable generation program as an example. If you want to know how much time people spend on paperwork, you can have supervisors check all the tasks in an inventory which are associated with paperwork. Then you can calculate the amount of work-time each person spends on that set of tasks or produce information concerning time spent on paperwork by various classes of people. If you wish, you can produce a two-way distribution between job satisfaction and time-in-service and find out whether job satisfaction tends to deteriorate at some point in time. Also, there is a reliability

program which enables you to determine whether the raters agree with each other when they provide judgements on such things as the difficulty levels of tasks in their occupation. There is a correlation/regression routine in the CODAP system which is useful for developing models. For example, you are trying now to get an equation to determine the worth of jobs for pay purposes. The CODAP regression program should be very useful in helping you to accomplish this.

[illegible]. Task factor programs form the fourth class of programs. What are the consequences of various tasks not being performed adequately? How difficult are particular tasks? If you want information about the nature of a task, you can collect supervisory ratings and use CODAP programs to analyse the information for you.

[illegible]. The fifth class of CODAP programs provides the means for interacting job information with task information. For example, there are programs for computing the difficulty of work performed or the average level of hazard faced by each individual surveyed. It would be impossible to indicate the full capabilities of the CODAP system in the time available today. For this reason, I have included on Annex B a set of abbreviated CODAP program descriptions prepared by Michael Thew and Johnny Weissmuller, lead programmers for the CODAP system in the Air Force.

QUESTIONS ABOUT THE JOB SURVEY APPROACH

15. Should one begin with surveys of officers or with surveys of enlisted personnel? We decided to begin with enlisted personnel, for a number of reasons. First, there's a lot more information available to construct inventories for enlisted personnel, including training standards, training course outlines and so on. Secondly, there are a lot more training courses for enlisted personnel, so there is greater possible money savings. Thirdly, the cost of administration per person is less because the sample sizes are larger. Fourthly, the tasks that enlisted people do are more visible; you can observe and verify what they claim to be doing. Finally, because of protocol problems, it's sometimes difficult to interview high level officers required for the construction of officer inventories. Despite the special problems with officers, I should mention that we have collected good officer data for specialties where the work is content-oriented. However, the cost of inventory construction is at least three times higher for officer inventories than for enlisted inventories, and the payoffs of survey results have been smaller.

16. Should you collect information from the worker, or from his supervisor? We decided on the worker. The first problem was that we wanted to survey everyone, including the supervisors, and the supervisors with many subordinates would have to work very hard to provide detailed information on all subordinates. Secondly, we believed that supervisors knew a lot about the

general nature of the work performed by their subordinates, but they do not know how work-time is distributed across tasks. Thirdly, there was the possibility of some gaming if the information was provided by supervisors only. This may or may not have been a valid concern.

17. What level of task specificity should be used? We have concluded that you should not hold to a single level of specificity. You can write relatively broad task statements for supervisors because they tend to supervise whole shops. With the worker himself, you have to be very specific. Specificity is related to the length of inventory. We don't like for a man to spend more than two hours in filling one out. However, it's amazing how many tasks you can get information on in two hours if you organize them under duties. People can then skip large numbers of irrelevant duties and check only those tasks under duties which they perform. Our experience has been that our inventories have become longer over the years. During the early time period, some trainers complained that some tasks were not specific enough for them to establish training objectives. If you write tasks which are too broad, you get little from the job-type analyses. With very broad statements, there is also the danger that two people checking a task don't do the same thing. For these reasons, we have tended to make our tasks more and more specific during recent years.

18. What kind of rating scale should be used? We use a time-spent scale in preference to a frequency scale. If you use frequency, all you can do with it is to report frequency distributions. Our "percent time" estimates have proved very useful. Time percentages have a clearly defined range and a base value of "0". For the individual case, the values sum to 100%. In a like manner, the average values for any group of workers also sum to 100%. Percent time values provide a convenient method for computing the overlap of two individuals or groups on specified subsets of tasks. All in all, we have been very satisfied with our decision to use percent time spent on tasks as our basic job information. These values may not be accurate enough for some applications, such as precise cost analyses; but they are accurate enough for job-type analyses, job evaluations, and job descriptions.

19. How broad should be the surveys? It's advisable to cover a whole occupational category from entry level to superintendent in a single inventory. Then you can find out the extent to which people are performing tasks appropriate to their grade and skill level.

20. Should a common set of verbs be used? Some people say that when you write task statements you should use a set of carefully-defined standard verbs. We don't do that. We use the verbs that the worker uses in his particular occupation.

21. How large should be the survey samples? If you only want one job description of what people are doing in an occupation, then several hundred cases will give stable information. But you may want to know what work is being done by females, unmarried, who are on their first assignment. If you have only 400 cases and you pull out the female subset, you may only find

one or two cases. If you want a data bank which is useful in addressing numerous management problems, then you must have large samples. The additional cost is not very significant. The main cost is in the construction of the inventory.

22. What is the cheapest way to construct inventories? Some of the United States services construct inventories by interviews only. We found that after you have interviewed six to twelve people, you get diminishing returns in terms of identifying new tasks. We start with written sources of information, prepare an initial inventory, and then interview a few people in the occupation. We add those tasks that are suggested and then mail the revised list to supervisors in all kinds of organizations in many locations. These field supervisors add tasks which are not in the list but which are being performed in their areas of responsibility. We find this the most economical method for developing a comprehensive task test.

23. How should you collect occupational data? Some services insist on group administration under controlled conditions. Incumbents are given thorough instructions before filling in the inventory. We started in this way, but found that some booklets coming from the field had grease fingerprints on them, as though not everyone was going to the testing room. When we researched this problem, we found that some people filled the inventory out on the job, some in testing rooms, and some at home. We divided the samples into those who were administered the inventory under controlled conditions and those who weren't. We couldn't find any difference in the information that we got back from these groups. Although the regulation about controlled administration still exists, we don't give it too much attention. If people are filling out inventories on their own time, then it's cheaper for the organization. The important thing is to have a control so that the inventories are returned to a central point for processing. We don't like to see inventories going through the hands of supervisors, especially if you have attitudinal questions in them.

24. What formats should we have for the outputs? If you don't make them simple, people won't use the reports. You must have your task statements and your information side by side. For trainers, you only give them what is relevant to training decisions.

25. Who should construct inventories? Inventory construction is an art, and that is the weakest part of the whole technology. It takes a lot of training for a person to become proficient. I don't think people in teaching jobs should construct inventories. They tend to emphasize only those tasks which are relevant to training. You must use someone who can go to all sorts of managers and find out the nature of their problems. I believe that a full-time professional staff does this job best. On the other hand, if the trainers don't participate in the inventory construction and are not ego involved, they won't trust the information and they won't use it. Therefore, they must be used in the review stage.

26. Should one collect names of incumbents? We always get people's names. If you don't get names and identification, you can't verify the accuracy of information. Secondly, if you

want to find out the impact of job changes on job satisfaction, you have to identify a group of people at different points in time. Unlike personality inventory data, task data are objectively verifiable. It's hard for an incumbent to say he does a task when everyone around him knows that he doesn't. One reason that we get good quality information is because people sign their names. On the question of privacy, the Air Force believes that management has a right to know what the workers are doing. With attitudinal questions, the worker gives information voluntarily. We have taken names from hundreds of thousands of cases and I can't remember hearing of an objection being lodged.

27. How do we know that the information is good? First, we had a contract with the University of Texas which showed that you can trust people to write in tasks that they are doing but which are not in the basic list. Then, we introduced veracity checks in which we placed a task in an inventory in two different locations to see if the person gives the same information twice. This tells you if he is reading the tasks. We check to see whether apprentices are claiming they do superintendent's tasks. We have test-retest studies in which we had incumbents fill out inventories several weeks apart to see if they provided consistent information. We found differences which worried us for a while. Then we found that many jobs change fairly quickly. What an organization does remains fairly stable, but the individuals' jobs change over time. We also compared people's time cards with what they put in an inventory. We telephoned people in the field and asked them what they meant when they said they performed certain tasks. Sometimes we found that we didn't have the right tasks in the inventory to capture the true nature of a job. For example, we found one supply group that spent more time obtaining signatures than issuing items. Then we found that a new type of job had come into play where expediters were delivering goods from the warehouse to the flight line. They obtained signatures for the goods, but we didn't have a task in the inventory concerning driving parts from a warehouse to a flight line. The real test of the quality of survey data came when people started to challenge results. For example, in a survey of the accounting and finance area, the occupational survey uncovered only 14 military personnel who claimed to be performing civilian pay functions. Yet, fully 25 percent of the content of the military Career Development course was devoted to such tasks. The Comptroller felt the survey data couldn't be correct, so he canvassed every Accounting and Finance Office to locate all military personnel performing tasks related to civilian pay. He was able to locate only 17 individuals. We projected from the occupational survey sample to the complete population, and the results predicted he should have found 17. This one study did much to convince HQ USAF that the survey procedure yields thrustworthy results. Considerable evidence has accumulated over time which gives us confidence in the data. Many changes have been made on training courses and in the classification structures based upon survey data, and these changes have survived. The very fact that the technology is still generally accepted after 20 years is evidence of its power and validity. We have many reports from agencies outside the Air Force who are convinced that they get good information using occupational survey and CODAP analysis procedures. Chart 3 in Annex C provides a

partial list of the many agencies and organizations using this technology. The Marine Corps modified their complete occupational structure using the data from the CODAP system and received a Presidential Management Award for this effort. Apart from the military, there is a consortium of States within the United States who are dealing with vocational and technical education. They use survey procedures and CODAP-type programs to ensure that vocational courses are on target with civilian industry. The University of Texas actually teaches a course in CODAP and that will help the academic world. Montreal Hydro, the second largest energy-producing business in the world, has a strong CODAP program. Control Development Corporation, a very large computer manufacturer in the United States, is using CODAP for job evaluation as a means to job pricing.

CONCLUSION

29. What I've discussed is the method of collecting data which describes what individuals do on the job. We know that the information is trustworthy. We have powerful tools for analysing this information and reporting job descriptions. We can collect data about the nature of tasks, such as how difficult they are and the consequences of not doing them properly. We can put all of this together to answer a large number of management problems.

CODAP IN THE OUTSIDE WORLD

MILITARY

US Marine Corps

US Army

US Navy

US Coast Guard

Australian Forces

British Navy

Canadian Forces

STATE AND LOCAL AGENCIES

VTECS

Prince George's County, MD

Commonwealth of Virginia

Texas Dept of Public Safety

Texas Education Agency

Texas Day Care Assn

UNIVERSITIES

University of Texas

Texas A&M

North Carolina State

John Hopkins University

INDUSTRIAL

AT&T

Ontario Hydro

CDC

GOVERNMENT

NSA

DIA

OPM (CSC)

FAI

Dept of Agriculture

NIH

ANNEX B TO
HISTORY OF JOB SURVEY
AND CODAP ANALYSIS
SYSTEM

CODAP PROGRAM SUMMARY

Listed below are descriptions of the major computer programs associated with the Air Force CODAP package. A six character computer code and title of each program is given, along with a brief summary of its capabilities.

AUTOJT Automated Job Typing
This program evaluates between-group differences for pairs of Job Descriptions to aid in determining distinct job types within the hierarchical clustering process. Six comparisons are computed and reported for each pair of job descriptions. These evaluations include difference in percent time on each task, percent time spent on each duty, percent members performing each task, number of tasks needed to account for a specified percent of total group time, and average number of tasks performed by each group.

AVALUE Average Values Per Task
AVALUE computes an average value for each task in the Job Inventory. The average value is based on a selected variable for all cases who perform that task. For example, this program might be used to compute the average number of months in service for those members performing each task.

AVGPCT Average by Percent Performing
AVGPCT computes an average value for each task in the Job Inventory. The average is based on the percent of members at each level performing. In other words, the average will be adjusted to account for unequal membership within each interval.

CODAPI Interface to Input Data to CODAP
The purpose of CODAPI is to provide an interface with other analysis packages. This program will take a COBOL-format file and create CODAP compatible data cards.

CODAPX Interface to Extract Data from CODAP
The purpose of CODAPX is to provide an interface with other analysis packages. This program will take a CODAP History or KPATH file and create a COBOL-format file.

COMGEN Composite Factor Generator
COMGEN allows the user to generate a special purpose FORTRAN program to perform operations on vectors from the Job Description file and produce new composite task factors.

CORREG Correlation and Regression Package
This program extracts up to 100 variables from a CODAP History or KPATH file and computes correlation matrices and regression problems. The correlation part computes and prints the correlation matrix, number of valid cases in the sample, and means and standard deviations of the variables. A series of regression problems may be computed using an iterative technique. The standard and raw score weights for each variable are reported, as well as the regression constants.

CURVES Curve Fitting and Plotting
This program finds the curve of best fit when predicting one variable (Y) from another variable (X) using polynomials. Provisions exist for plotting the curve of best fit with scattergram of actual observations superimposed. At the end of each report a summary is printed which includes means and standard deviations, the correlation matrix, and a regression problem table including RSQ, regression weights and constant.

DIAGRM Diagram of Clustering Process
This program generates a treelike diagram that visually displays the order in which groups merged during the hierarchical grouping process. Each node of the tree, representing one stage, displays the number of members at this stage, the KPATH range defining the membership, and the best and average values.

DICTXX Print Variable Dictionary
DICTXX will provide the user with a list of variables, titles, and their respective formats as defined on the history or KPATH file.

DIST2X 2-Way Distribution
DIST2X reports a cross-tabulation of values for two variables, either computed or background, for specified cases. In addition to raw frequency, percent of total row, total column, and/or total sample, mean and standard deviations may be displayed. An additional row or column labled "other" may be added to account for values outside the specified limits.

DUVARS Duty Variable Computations
For each individual case, DUVARS computes the total percent time spent in each duty, the number of tasks performed in each duty. They may be stored as new background variables on the history or KPATH file.

EXTRCT Reprinting of Reports
Extract will reprint any report or group of reports saved on the CODAP Report file during an analysis.

FACCOR Task Factor Correlation
This program will extract up to 100 factors on the CODAP FACSET file and compute correlation matrices and regression problems. The computations and reports are like those of CORREG.

FACEXT Factor Extract
FACEXT will extract up to 100 vectors on the CODAP FACSET file and write them to a COBOL file. The purpose of this program is to establish an interface to other statistical packages available outside CODAP.

FACGEN Factor Generator
The purpose of FACGEN is to modify and/or load task factors for future processing within the CODAP system. Modifying consists of raising values to a specified power, standardizing to a mean of 5.0 and standard deviation of 1.0, or the substitution of rescaled or rank ordered values.

FACPRE Predicted Factors
FACPRE will apply the regression equations developed by FACCOR or predicted factors, the regression equation including titles for the input vectors, the number of observations, product-moment correlation and product-moment correlations squared, and the standard error of the estimate. The mean, moment about the mean, standard deviation, coefficient of variation, and minimum and maximum values are reported in columnar format for easy comparison of the criterion versus the predicted factor.

FACPRT Task Factor Print Program
This program allows the user to print any of the factors on the CODAP FACSET file. Its capabilities include calculating and reporting differences, cumulative percentages, categories of tasks, means, standard deviations, and summations. Report formats may be tailored in a variety of ways to meet the needs of different users.

FACSTD Input Standard for Factor Raters
FACSTD creates the CODAP Rater History file. Its specifications are similar to that of INPSTD except that raw task responses are stored instead of relative percent time spent.

GRMBRS Group Membership
This program produces a detailed report which describes the two groups combining at each stage of the hierarchical grouping process. The information reported includes: stage numbers, number of members in the combined group, KPATH range of the member cases, number of members in each merging group, average overlap between merging groups, and average overlap within the combined group.

GROUP Hierarchical Clustering
GROUP is the program that actually performs the hierarchical clustering in the CODAP system. At every stage, the two most similar groups are identified and combined. Once combined, the similarity of this composite group with all groups is reassessed. This collapsing process is continued until only a single group remains. The output from GROUP is used by the KPATH

program to incorporate the clustering information back into the mainstream of the CODAP system.

GRPDIF Group Differences
This program will report the task-level differences between the two job descriptions. Percent time spent or percent members performing each task is used as the basis of computation. Correlations between the percent time spent vectors and between the percent members performing vectors may also be obtained. That data may be either percent members performing or average percent time spent by all group members.

INPSTD Input Standard for Job Incumbents
INPSTD creates the standard CODAP History file. This program stores percent time spent computed from raw relative time responses Duty/Task title cards and History variable definitions are combined with the case data and reorganized in History file format. INPSTD will accept 20,000 cases, 1700 task ratings, 6000 characters of History data per case, and 2[illegible] duty categories.

JOBGRP Compute Stage Job Descriptions
Given a stage number from the hierarchical clustering process, this program identifies all members in the group formed at that stage and computes a composite job description for those cases.

JOBIND Print Individual Job Description
This program prints a job description with specified background information for each individual in a selected group.

JOBPRT Job Description Print Program
This program prints job descriptions computed by JOBSPC or JOBGRP. They may be ordered by task, task within duty, or by modules.

JOBSPC Compute Special Job Descriptions
Given the membership criteria in terms of computed or background variables, this program identifies all cases meeting these requirements and computes a composite job description for that group.

JOBSXX Audit Job Description
JOBSXX is designed to compute and print job descriptions from all cases on a History or KPATH file in three different sort sequences.

KPATH Create KPATH File
This program will resequence cases on the History file as defined in the clustering process.

MODSXX Audit Module Definitions
MODSXX will print a task listing ordered by module categories. Tasks not included in any module definition will be placed in a module called "Tasks Not Referenced" and printed at the end of the report.

MTXPRT Print Overlap Matrix
This program computes the overlap between all pairs of input composite job descriptions and reports these values in matrix form. Overlap may be computed in terms of average percent time spent on tasks or in terms of the number of tasks performed in common.

OVRLAP Overlap of Response Patterns
OVRLAP calculates the similarity between all pairs of cases on the History file. The data are arranged into a matrix format for processing by the GROUP program. History files of 7000 cases or less may be input to this.

PLOTIT Plot a Task Factor Histogram
This program accepts an input task factor and plots a histogram showing the distribution of values.

PLTVAL Plot Mean and Standard Deviation Values
PLTVAL is designed to produce a plotting of the mean and standard deviations for a given factor.

PREFAC Predicted Factor Report
PREFAC will apply the regression equations developed by TSKCOR or CORREG and produce a task factor representing this predicted factor. This program is being replaced by FACPRE. Input is a job description file rather than a FACSET file.

PROGEN Program Generator
PROGEN generates a FORTRAN program from high-level commands and standard FORTRAN statements to perform any operations on the incumbent data found on the History or KPATH file. Its primary use is to add new computed and/or history variables.

PRTVAR Print Variable Values
PRTVAR will print the values of selected variables for all cases on the History or KPATH file. The output is often used in the job-typing process.

RANSEL Random Case Selection
RANSEL will produce a membership identification vector useable as input to the program SUBSET. Given the membership vector from a current job description, this program will randomly select cases based on a percentage of the total or a specific number.

REXALL Inter-rater Reliability
This program computes and reports the average inter-rater reliability coefficient of a single rater and the stepped-up reliability coefficient for the total group of raters. The program is used in conjunction with sets of task ratings made by a large number of supervisory personnel. REXALL computes the correlation of each rater's responses to the grand mean vector on those items he or she rated. Other statistics are available to identify deviating raters. The program permits the user to ignore these cases on subsequent

passes. Also reported are the mean task ratings and the standard deviations of the ratings for each task.

REXSPC Special Task Factor Computation
REXSPC will compute composite task factors, from rater data, based on selected background items.

SETCHK Check Sets of Raw Data Cards
SETCHK edits the raw data which will be input to the program INPSTD. Only complete cases are kept for further processing.

SUBSET Create a Subset History/KPATH File
SUBSET will create a new History file containing only those members as defined by a composite job description

TASKXX Duty and Task Title Print
TASKXX is designed to print a list of the duty and task titles as entered in the INPSTD program.

TSKCOR Task Factor Correlations
TSKCOR is being replaced by FACCOR. Input is a Job Description file instead of a FACSET file.

TSKNDX Task Index
TSKNDX computes and prints the following information for tasks performed by a selected group of members: task titles, mean rating value ("Task Index"), percent members, and cumulative sum of average percent time spent by all members.

VARGEN Variable Generator
VARGEN will compute new variables for every case on the History or KPATH file. These variables are based on the individual's task response data. Some of the values computed are: average task difficulty per unit time spent (ATDPUTS), overlap or an individual's time spent with a given job description, and time spent over a specified set of tasks. When comparing a rater with a given task factor policy, VARGEN can compute the sum of absolute difference, sum of squared differences, and Pearson product-movement correlations.

VARSUM Variable Summary
VARSUM computes and prints frequency distributions for specified intervals, reports total frequency counts, and calculates means and standard deviations on selected background and computed variables for any group of individuals whose job descriptions has been generated by JOBSPC or JOBGRP.

VARPCT Variable Percent Summary
VARPCT produces the same output as VARSUM except that instead of reporting frequency counts, percentages are used.

VARSXX Variable Value Audit Distributions
VARSXX is designed to produce a listing of the actual responses, either history or task, given by all incumbents on a History or KPATH file. This output is very useful for establishing specifications for the VARSUM and JOBSAC programs. It is also used as an auditing tool of the History file after INPSTD.

OCCUPATIONAL ANALYSIS

SATISFYING THE INFORMATION NEEDS OF MANAGERS

By Dr. R.E. Christal

INTRODUCTION

1. I'd like to start with the statement that occupational information does not solve management problems. To the contrary, such information often serves to bring into sharp focus problems that have gone unrecognized. Yet, detailed and trustworthy information about jobs and people can be the keystone for good personnel management, and I believe that a manager armed with occupational survey data and the CODAP analysis system is in a position to function effectively.

APPLICATIONS

2. Below are listed some of the important problem areas where managers can make good use of CODAP. While the list is not exhaustive, I'm sure you will recognize that it does cover the major components of personnel management. Throughout the week, I will discuss most of these application areas. During this session, I will give examples of studies we have accomplished associated with personnel utilization, classification structures, and job requirements.

MAJOR APPLICATION AREAS

Personnel Utilization	Classification Structures
Job Requirements	Training Requirements
Skills Management	Manning
Manpower Analyses	Job Evaluation

Personnel Utilization

3. Personnel utilization has the most direct application with CODAP. We've had questions such as the following: Are Air Force supervisors discriminating against minority groups in work assignments? How are women being utilized in aircraft maintenance jobs? When a person is promoted, how does his job change? Does he take on new types of activities appropriate for his higher grade level? Do officers perform some tasks that would be better performed by enlisted personnel? How do civilian and military employees share the work loads when they are working side by side? What impact do civilians have on the nature of military careers? What do people do in the first three months on a job? What are the first activities that supervisors tend to assign to new workers? What is it about their jobs that make

people happy or unhappy? Now, I don't know what your specific questions are, but if you need information about a subset of individuals, then you have a straightforward application of CODAP that can be done quickly and efficiently. I will briefly describe four applications of CODAP to problems concerning personnel utilization. They relate to: discrimination against blacks in terms of work assignments; utilization of women in non-traditional jobs; utilization of low mental level personnel; and the sharing of work by nurses and medical service personnel.

4. I'm sure that all of you are aware of the social movement in the United States which is designed to assure equal and fair treatment to all of our citizens, regardless of race, religion, sex, or national origin. The military services have always led in such movements. For example, the races were housed together by the services long before integration became a big push in the civilian sector. However, the question was asked as to whether discrimination was occurring at the lower levels. Do supervisors treat whites and blacks differently? Do they assign to blacks the simple mundane tasks, while giving the more responsible and satisfying tasks to whites. How do you address a question like that? You can't simply ask supervisors because, if you suspect a bias, you wouldn't trust their answers. Our approach was to apply CODAP to occupational survey data to determine the nature of work being assigned to each individual, and then to analyze this information for bias in work assignments. Our sample consisted of 11,000 cases in 12 occupations, 23 percent of which were blacks. Holding constant such factors as grade and time-in-service, we used the multiple linear regression model to compare blacks and non-blacks in terms of the number of tasks performed, job difficulty, reported utilization of talent, and job interest. We were able to provide a precise answer to the basic question because of the availability of occupational data and the CODAP system. Essentially, no discrimination was uncovered. In 10 of the 12 occupations analyzed, there was no difference in the nature of work assigned blacks and non-blacks. In two occupations, blacks were assigned slightly less difficult work than non-blacks. However, in both instances, the blacks reported higher interest in their jobs and better utilization of their talents than non-blacks.

5. During the 1960's, there was a great experiment in the United States in which thousands of individuals were entered into the military services who scored lower on mental tests than existing cutting scores. The goal was to see if the services could make good use of them. There were difficulties in getting this sample through entry-level courses. Many individuals had to be given remedial training. However, eventually, most of them completed courses and were assigned to jobs. The question was whether they carried their load in the operational setting. Supervisory ratings of job performance were obtained which indicated that most of them were performing their jobs satisfactorily. But there was a problem with this. Suppose you had an individual working for you who didn't seem very bright. You assign him the relatively mundane tasks, and he attacks them with enthusiasm and does an excellent job. How

would you rate his performance? You would probably indicate he performs his job in an excellent manner. If this example were replicated throughout the services, we might make a mistake in evaluating the utility of lower mental level personnel. Management needed to know not only how well the lower mental level individuals were performing their assignments, but also whether they were performing the same difficulty of work as their higher mental level co-workers. We were able to analyze occupational data using the CODAP system to answer this question. We found differences to be small, but they were significant in a number of occupational areas. An interesting observation was that low aptitude people could fill out job inventories. The rejection rate on booklets that were filled out by the low mental level group was two percent. Our normal rejection rate for qualified people had been about one percent. I think one of the reasons for our success was that we wrote task statements in the words of the worker, and even a person with a limited vocabulary does pick up the vocabulary of his own occupation. That's one reason I don't like to use standard verbs for task statements. While I am on this topic, I should mention an Army study of low aptitude personnel which I think was of consequence. They found that the primary difference between lower aptitude and higher aptitude people was not the ultimate level of performance obtained from those individuals, but how long it took them to reach a satisfactory level of skill. The lower aptitude people eventually got there, but it took more time. It appears that a primary factor measured by aptitude tests is the time required for skill acquisition. That's an important concept.

6. One of the ways the Air Force hopes to solve its manning problem during the 1980's is by greater utilization of women. I understand that the manpower plans call for 80,000 women in the Air Force by 1982. We are very anxious to find out how well women will perform jobs of the nontraditional type. In a recent probe study, we administered a job inventory in the Aircraft Mechanics career field. In the sample, we had 5825 males and 206 females. The first problem we encountered in this study was that one half of one percent of the mechanics misidentified their sex. That's not a high error rate, but it is serious because about 30 men out of approximately 6000 called themselves female. This error had to be corrected. The second problem was that the average time in service by males and females differed by about three months. In order to make a fair comparison, we took every female and drew out at random about five males with the same lengths of service. This provided two samples which were comparable in terms of service time. Next, we divided our job-types into two classes - maintenance jobs and support jobs. The support jobs were concerned with scheduling, safety job control and things of that nature. Table 1 shows the sizes of the survey and analysis samples.

8-43 Months Total Active Federal Military Service (TAFMS) Survey Sample			
		Males	Females
TAFMS	Number	1959	206
	Mean (months)	25.8	22.9
	Std Deviation	10.1	7.3
8-43 Months Analysis Sample			
		Males	Females
TAFMS	Number	1015	202
	Mean (months)	22.9	22.9
	Std Deviation	7.2	7.3

Table 1. Selection of Sample for Utilization of Women Study. Aircraft Mechanics 431 x 1 C, E, and F.

7. Table 2 shows the distribution of cases across the support and maintenance jobs. There was a higher percentage of women in support jobs, and a higher percentage of men in the maintenance jobs.

SUPPORT JOBS	MAINTENANCE JOBS
Tech Orders	Crew Chiefs*
Training	
Documentation	Inspection
Scheduling	Special Maintenance
Safety	
Job Control	
Deficiency Analysis	
Bench Stock	
CONTAINS	CONTAINS
5.6% of males 26.2% of females	94.4% of males 73.8% of females

*59% of all males and 44% of all females work in "Crew Chief" jobs.

Table 2. Distribution of Males and Females in Support and Maintenance Jobs.

The next step was to divide months of service into first year, second year, third year and beyond. As can be seen in Table 3, the number of males in the support jobs builds up over time, but not as fast as for females. A greater percentage of females move from hard-core maintenance to support jobs over time. At this rate, by the end of four years, about 45 percent of the females will be in support jobs. We don't know why this is happening; whether its because they are more talented for support jobs (some of which are quite difficult) or because they are unable to perform the maintenance tasks. As I said before, sometimes all you can do is identify the problem.

TAFMS	% OF MALES	% OF FEMALES
0-12	3.74	8.70
13-24	3.69	17.92
25-43	8.65	43.84
TOTAL	5.62	26.24

Table 3. Percentage of Males and Females in "Support" Job Types by TAFMS.

8. Next, we classified the tasks into certain categories and computed the information in Table 4. The women in the maintenance job types are performing work very similar to men. Notice that they are performing both "heavy" tasks and "dirty" tasks. However, there are considerable differences in the work performed by men and women in the support jobs. The data shown in Table 5 are even more revealing. Approximately 74 percent of the women and 94 percent of the men were assigned to the "hard core" maintenance job types. Within these job types, there is very little difference in the duties performed by the two sexes.

Class of Tasks	Support		Maintenance	
	Male	Female	Male	Female
Clerical	26.4	46.7	5.6	6.8
Heavy Maintenance	2.5	.3	8.6	8.3
Light Maintenance	5.6	1.2	14.6	13.9
"Dirty" Maintenance Tasks	.8	.6	8.6	8.3
Inspect, Check, Troubleshoot	8.6	3.2	37.2	37.2
Other (Support, Non-Clerical)	56.0	48.1	25.3	25.4
AVG NO OF TASKS PERFORMED	28.1	18.8	157.9	141.1
AVG TASK DIFF. PER UNIT TIME	4.4	5.0	4.4	4.3

Table 4. Percentage Time Spent on Various Classes of Tasks by Men and Women in "Support" v "Maintenance" Job Types.

Duty	% Time Male	% Time Female	% Time Difference
G Performing General Aircraft Maintenance	22.61	22.53	0.08
H Performing Ground Handling of Aircraft	20.03	21.63	-1.60
I Maintaining Landing Gear Systems	11.24	9.88	1.36
M Maintaining Electrical Systems	6.32	7.27	-0.95
K Maintaining Flight Control Systems	5.19	4.56	0.63
Q Performing General Engine Maintenance	5.05	4.43	0.62
L Maintaining Pneudraulic Systems	5.00	5.37	-0.37
E Maintaining Forms and Records	4.79	5.55	-0.76
O Maintaining Non-Powered AGE Equipment	4.45	3.80	0.65
N Maintaining Fuel Systems	4.17	4.04	0.13
J Maintaining Utility Systems	3.23	3.14	0.09
F Performing Supply Functions	2.46	2.51	-0.05
C Inspecting and Evaluating	1.54	1.41	0.13
Subtotals	96.08	96.12	

Table 5. Percentage Time on Various Duties for Male and Female Personnel Working in Maintenance Job Types.

9. We took this analysis a little further. There were 111 tasks performed by men which no women were doing. Actually, the men spent only a fraction of their time on those tasks. We analysed the tasks in terms of difficulty, lifting requirements, and so on, but found nothing significant. We concluded that women could perform these tasks, but we identified none because of sampling error. We simply failed in our small sample to pick up women performing these tasks. Finally, as a summary, we correlated time spent across all the tasks in the inventory. (See Table 6) We can say, with some assurance, that there is no difference in the work performed by men and women in maintenance job types. Perhaps the most consequential thing to come out of the study concerns aptitude scores. Women scored so low on the mechanical tests that we had to waiver the mechanical aptitude requirement for maintenance workers. You will see in Table 7 the percentile scores for males and females. The mean score for males is 68 and the mean score for females is 39. That's a tremendous difference. Women scored very poorly on mechanical aptitude tests; yet we discovered that in the maintenance area, women were performing the same tasks as men. We looked at the contents of the tests and found that they were oriented toward mechanical experience. There were questions about the recognition of shop tools and questions about automotive mechanics which men have been exposed to all their lives. But many women had no previous exposure to those experiences. We believe now that we need a different type of mechanical test for women which is not experience bound.

Variables	Correlation: Male vs Female
% Time spent on tasks in MAINTENANCE Job Types	.97
% Performing tasks in MAINTENANCE Job Types	.99
% Time spent on tasks in SUPPORT Job Types	.69
% Performing tasks in SUPPORT Job Types	.58

Table 6. Correlations Between Male and Female Work in 431x1 C, E & F.

Aptitude Composites	Mean Male	Mean Female
Mechanical	68.9	39.2
Electronic	64.5	60.7
General	60.7	69.9
Administrative	47.6	63.4

Table 7. Aptitude information for Analysis Sample 431x1 Utilization of Women Study.

10. A few years ago, the Surgeon General and the Chief of Nurses were concerned about the shortage of trained nurses. They wanted to know the extent to which the work of trained nurses and medical services specialists overlapped. We built a multi-occupational inventory encompassing all the tasks known to be performed by nurses and enlisted medical services personnel. After the survey, we were able to perform a direct analysis of the tasks which are shared by the two groups. We found considerable overlap in the work performed. There were some differences in the way people were distributed across job-types, but it appeared that additional medical services personnel could reduce the requirement for nurses. The work done by enlisted people was not mundane. As a matter of fact, tasks like minor surgery were performed more often by enlisted personnel than by nurses.

11. In another interesting study, we asked medical services technicians to design their own jobs. They were instructed to check the tasks that would be in the job and to allocate work time to those tasks. The technicians were very realistic; they put into their job description things like emptying bed pans because they recognized it as a task that had to be done.

Classification Structures

12. Decisions on how to fit jobs into occupational categories are very consequential. They determine the cost and the effectiveness of training programs because you have to train people for the entire occupational category. Classification decisions also determine the flexibility of personnel utilization and the breadth of people's careers. If you have a narrowly prescribed category, you know what a man can do after eight years experience. On the other hand, in a broad category with many different job-types, you may not know what direct experience each person has had. In Australia, the classification of categories has a bearing on pay, and that is of great consequence.

13. Again, I must point out that information from a CODAP job-type analysis does not prescribe a solution. It will describe the problem and provide a lot of associated information for the people in the classification business. The CODAP system will indicate how many individuals are in each job-type under consideration and where they are located. This information is important to avoid creating new occupations only to discover that half the jobs are overseas or in remote locations.

14. Jobs that are put together into an occupation need to be somewhat homogeneous in terms of job requirements, otherwise some jobs could be performed by people who are not very bright while other jobs would require very talented people. In a case like this, if you set the requirements for the most difficult job, then you would waste the talents of the people doing the simpler jobs. If you survey an occupation once, you get a static picture; if you survey at two points in time, you get a dynamic picture which tells you how many people move from one

job-type to another during a given time period. We discovered that in some of our occupations, people were staying in the one job-type through a major part of their career. This means that a lot of the training given to these individuals was never utilized.

15. When the US Marine Corps adopted CODAP technology, they decided that their classification structure was too broad. This is part of the debate about specialization and generalization. Training is easier if the structure is highly specialized, but there is less flexibility in the personnel utilization. The Marine Corps used the CODAP job-type analysis system in the redesign of their classification structures and received a Presidential Award for management improvement as a result of this exercise.

16. I must admit that occupational data is better for splitting occupations than for merging them. You can use a multi-occupational inventory to answer precisely the extent to which people in two occupations are doing the same tasks, and you can look at job requirement data to see if aptitude levels and physical strength requirements are the same for the two occupations. The question one can't answer directly is how easily people in one occupation can learn to perform the tasks in the other occupation being considered for meger.

17. You might be interested in a recent change in the USAF classification structure which involved the creation of new Senior Manager positions. Evidently, there were complaints that people at the top grade level (E9) were not being fully utilized. The Chief of Staff decided that we should look at the possibility of combining occupations at the top levels. That meant that Senior Managers would handle multi-occupations. We produced for the classification people the top grade job descriptions for all the occupations for which we had data. We discovered that, in most occupations, E9's do work that is managerial in nature. They help draft the budget; they arrange space for people; they assign people to work stations; and they coordinate activities with other organizations. In most cases, they do not perform the work tasks that the journeymen perform. However, in some occupations, some of the more complicated technical tasks were being performed by E9's. From this information, the classifiers were able to determine where they could collapse two occupations because all of the duties were managerial. The Director of Classification Structures Branch said that he was very pleased with the data because several proposed recommendations would have caused serious problems if they had been implemented. The occupational information available enabled him to make good decisions.

18. In one study, we were able to demonstrate, using the CODAP system, that the classification structures for the Accounting and Disbursement Career ladders were allowing technically incompetent individuals to be placed into supervisory positions. The problem was generated by the fact that the two ladders were separated at the apprentice and journeyman

levels, but merged at the first-line supervisory level. Thus, it was possible for an enlisted man to spend the first part of his career in the disbursement ladder and end up being a supervisor of individuals in an accounting shop. He would find himself in the position of having to certify the accuracy of accounts, having no idea concerning how they were developed. Using the task inventory, we were able to get agreement from supervisors concerning "critical tasks" than an individual should not be asked to supervise unless he has had direct experience in performing the task. We then conducted an occupational survey of supervisors to determine their experiences on such critical tasks. The data clearly indicated that the classification structures were generating serious problems, so the Disbursement and Accounting ladders were separated through the first-line supervisory level.

Job Requirements

19. Job requirements can be classified as physical, mental, and psycho-physical. I'll discuss the use of CODAP in establishing mental requirements in a later paper. For the moment, I'll address the physical requirements. The Air Force is concerned about the enlistment of a large number of women. Although there's an overlap in the distribution of strength between men and women, women as a group don't have as much upper torso strength as men. The question was whether our occupational data bank could be used to help determine the stamina and strength requirements for the various occupations. The goal was not sex oriented, since any screening system would be designed to weed out both men and women not having sufficient strength to perform the required work. Our goal was to determine the strength and stamina requirements for all tasks in the Air Force. The study was straightforward because of the availability of task inventories and the CODAP analysis technology. First, we had supervisors in each occupation review task lists and check those tasks which, in their judgement, yields variance in performance as a function of strength or stamina. They also wrote in any demanding tasks which were not in the inventory. In the second step, tasks identified as requiring significant strength or stamina were rated on scales, such as the one presented in Table 8 . The third step involved collection of additional information about requirements, such as whether they involved carrying, pushing, lifting, etc. The fourth step, which is about to be executed, will involve on-site validation of the ratings through physical measurements for a sample of tasks. If this is successful, tests of strength and stamina will be developed to measure individual capacities, and individuals will be assigned to jobs only if they can meet the defined strength and stamina requirements. It should be noted that the availability of task inventories and the CODAP system make studies of job requirements feasible. In the near future, we hope to accomplish a similar study to identify the psychomotor and perceptual requirements for Air Force Tasks.

SCALE VALUE	DESCRIPTOR	LIFTING BENCHMARK
0	No Sig Demand	0-9 lbs OR EQUIVALENT EFFORT
1	Extremely Light	10-19 lbs "
2	Very light	20-29 lbs "
3	Light	30-39 lbs "
4	Light to Moderate	40-49 lbs "
5	Moderate	50-59 lbs "
6	Moderate to Heavy	60-69 lbs "
7	Heavy	70-79 lbs "
8	Very Heavy	80-89 lbs "
9	Extremely Heavy	90 lbs OR MORE

Table 8. Physical Demand Scale.

CONCLUSION

20. I have mentioned only a few ways that occupational information can be used to help solve management problems. I hope to describe many other applications during the remaining part of this symposium.

OCCUPATIONAL ANALYSIS AND ELECTRONIC THEORY TRAINING: THE PAYOFF FOR MANAGERS

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INTRODUCTION

1. The Royal Australian Air Force (RAAF) conducts occupational analysis from the Ground Training Division at Headquarters Support Command (HQSC). In analyzing occupational survey data, the Comprehensive Occupational Data Analysis Programmes (CODAP) are used in conjunction with analysis procedures researched and developed by the United States Air Force (USAF). This method normally employs the task as its basic unit of analysis. However, in 1975 the USAF Occupational Measurement Centre developed a variation of this procedure using knowledges in the form of electronic principles as well as tasks as basic units of analysis. The resulting survey instrument was to become known as the Electronic Principles Inventory, or EPI for short. In 1977 the RAAF became interested in evaluating electronics training and so developed the RAAF version of the EPI.

AIM

2. The aim of this paper is to familiarize the reader with the EPI and its use in developing and maintaining a programme of cost-effective, timely electronics training. More specifically, the philosophical background and historical development of the EPI, both in the USAF and the RAAF, will be discussed; examples of EPI data obtained from the RAAF will be presented; and precautions for employing results of survey data in the training environment will be discussed.

PHILOSOPHICAL BACKGROUND

3. In the middle 1970s, in the area of electronics training, the USAF was spending some $500,000 a day in preparing men and women to take one of 63,000 positions involving the use of electronic principles. Such an expenditure was necessary to support the philosophy of training which was in vogue at the time: When in doubt as to the utility of training, give it to the student just to be on the safe side. In other words, the attitude was that extra training certainly wouldn't hurt, and it served to virtually insure that course graduates would receive training on whatever they might later encounter.

4. Nevertheless, there are serious problems with this philosophy of overtraining. First, overtraining may engender in the student a set of expectations about what his job will be like when he completes his training. The logical assumption for the student to make is "I must be going to do this, or they wouldn't be training me to do this." If "this" is particularly interesting or exciting to the student, then he begins to build a set of expectations about what his job will be like; and if, when he gets into the field, those expectations are not fulfilled, his reaction could be detrimental to the service. For example, he might feel that he has been conned, and thus resent the service and everything associated with it. Or, he may accept the lack of correlation between his training and his job and carry on in some state of confusion. But even more likely is the prospect of his reacting with disappointment and dissatisfaction with a job that does not fulfill his expectations: expectations which he logically formed but which in his view have remained illogically unfulfilled. What compounds the problem of dissatisfied airmen is the probability that, because they are dissatisfied, they will leave the service at their earliest opportunity, taking with them their experience and some very expensive training.

5. This brings us to the second major problem with overtraining-the problem of cost. Training in the area of electronics is expensive particularly in terms of the equipment necessary to provide that training. And because ability and knowledge in electronics are marketable attributes in the civilian community, costs, in the form of replacement training, are increased as significant percentages of trained personnel leave the service for civilian jobs. In these days of rising costs and scarce training dollars, we can no longer enjoy the "luxury" of overtraining. It makes little economic sense to train 100 percent of the airmen in a mustering on technical tasks that only 10 or 15 percent of them will be called upon to perform; and unfortunately, what is trained is becoming more and more influenced by economics.

6. Against this backdrop of increasing costs and scarce training dollars, the USAF in 1974 was forced to ask the question, "Is our electronic principles training cost effective?" In other words, are airmen using the electronic principles they have been taught, or do many of these principles fall into the category of "nice to know information" which usually bears little effect on their ability to perform their day to day jobs? It was this question which gave birth to the EPI.

DEVELOPMENT OF THE USAF EPI

7. The EPI is a means of determining what electronic principles are being used by various groups of airmen in the field. It accomplishes this by asking airmen to answer "yes" or "no" to a series of questions concerning the electronic principles they are using in the performance of their jobs. It differs from the ordinary occupational survey in two important ways. First, the EPI asks <u>two</u> general questions: 1) What do you do? and 2) What electronic knowledge do you use to do it? Traditional occupational surveys only ask the first of these two

questions. Second, the EPI may be administered to any specialty or mustering, where ordinary occupational surveys are usually mustering-specific.

8. The EPI was developed by the USAF Occupational Measurement Centre in three distinct phases. Beginning in late 1974, a detailed review of literature concerning electronics training was conducted. This review gave the inventory developers a broad overview of technical information which they could draw upon in the development of the first draft of the EPI. That draft contained 574 items which represented some 40 percent of electronic principles then currently being trained in the USAF.

9. After field-testing this draft inventory in five USAF specialities, full scale development of the EPI began. Ten specialists in electronics training spent three weeks reviewing, revising, and adding items to the draft EPI developed in Phase I. The resulting document consisted of 1257 electronic principles items which were grouped under 62 different headings or subject matter areas. These 62 areas covered all electronic principles then currently being trained by the various USAF technical training schools.

10. After field-testing this final version of the EPI, a full-scale administration to all members of a USAF technical occupational area was undertaken. Results of this survey and the previous field tests indicated considerable variation across individuals and groups of individuals with respect to the number of electronic principles required in the performance of their jobs. Some specialties' members used large numbers of principles, while others' used only comparatively few principles in the performance of their jobs. These data offered considerable encouragement to those who were seeking a means of validating electronics training in the USAF, and the EPI's potential applicability in other services was quickly recognised.

DEVELOPMENT OF A RAAF EPI

11. In 1977, the situation with respect to electronics training in the RAAF was recognised as being similar to that in the USAF. In a letter from Air Force Office to Staff Officer Ground Training at HQSC, increasing complexity of equipment and escalating costs of training and manpower were cited as major factors in bringing to the forefront the need to look critically at the electronics training then being offered to various RAAF musterings, specifically six technical trades trained at the RAAF School of Technical Training (RAAFSTT), Wagga. Coincidentally, Air Force Office received a copy of a recently completed USAF EPI report. The combination of these factors culminated in a request from Air Force Office that the GT division undertake a project similar to the USAF EPI, with the ultimate aim of validating existing electronics training in the RAAF.

12. Accordingly, a technical expert in the area of electronics was attached to the Occupational Analysis and Training Evaluation Section of the Ground Training Division at HQSC for a six week period. During that time an EPI patterned after the USAF EPI was drafted and was reviewed by officials and technical experts at RAFFSTT. The survey instrument was field tested at RAAF Base Laverton, with members from all six musterings to be surveyed participating. The resulting instrument contained 1039 items organized under 23 headings.

13. Once construction and validation of the inventory were completed, the survey instrument was administered to all airmen in the ranks of Aircraftsman (AC), Leading Aircraftsman (LAC) and Corporal (CPL) in the Engine Fitter (ENGFITT), Instrument Fitter (INSTFITT), Electrical Fitter (ELECFITT), Motor Transport Fitter (MTFITT), Armament Fitter (ARMFITT) and Air Frame Fitter (AFFITT) musterings. These data were collected from October - December 1977. Results of the survey (to be discussed in general later in this paper) were so gratifying in terms of their potential utility that another Electronic Principles Survey, this time of three Radio musterings, was requested immediately by Air Force Office. Since the original EPI had been developed to cover those principles trained at RAAFSTT, additions to the survey instrument were needed to cover additional principles trained at the RAAF School of Radio (RADS). These were obtained through the efforts of several subject matter specialists at RADS, and the resulting modified EPI, containing 1509 items grouped under 26 headings, was ready for administration. Members of the Radio Technician Air (RADTECHA), Radio Technician Ground (RADTECHG) and Telecommunications Technician (TELSTECH) musterings in the ranks of AC, LAC and CPL were administered the survey during September - December 1978 with Survey results again demonstrating great potential utility.

SAMPLE DATA FROM THE RAAF EPI

14. Data obtained from the two electronic principles surveys generally show the percentages of any group of interest that make use of or perform the various principles or tasks. Those groups that are generally of most interest are either the mustering as a whole or the specific ranks within a mustering. In this section we will look at some examples of how these data may be used to address specific problems within the training environment.

Commonality Between Musterings

15. One question that was implied in the initial request for the development and administration of the EPI in the RAAF was, "Are there sufficiently large numbers of principles employed in common across musterings to justify common electronic principles training for those musterings?" Tables 1 and 2 give examples of how EPI data can be used to address this question. In Table 1, a great degree of similarity of principles usage is demonstrated between the RADTECHA and RADTECHG musterings in the general area of pulse techniques. In Table 2, however, little similarity is demonstrated

between RADTECHS and TELSTECHS in their usage of principles from the area of navigational aids and clippers and clampers.

Principle	% Using, RADTECHA	% Using, RADTECHG
GENERAL AREA: PULSE TECHNIQUES		
Refer to pulse	60	60
Refer to pulse duration	55	55
Refer to pulse width	62	60
Refer to pulse repetition time	59	57
Refer to pulse period	48	45
Refer to pulse repetition note	53	50
Refer to pulse interval	49	48
Refer to pulse duty cycle	51	45
Refer to pulse space ratio	38	47
Refer to pulse width modulation	20	26
Refer to pulse width demodulation	16	22

Table 1. Example of High Similarity Between Musterings

Principle	% Using, RADTECHG	% Using, TELSTECH
GENERAL AREA: NAV AIDS		
Use or refer to single current signalling	2	89
Use or refer to double current signalling	2	86
Use or refer to waveshapes of telegraph impulses	1	84
Use or refer to characteristic distortion	0	63
Use or refer to effects of live resistance	1	56
GENERAL AREA: CLIPPERS AND CLAMPERS		
Required to understand function of a positive clipper	69	27
Required to understand function of a conducting valve	61	36
Required to understand function of zener diodes in clippers	56	30
Refer to function of a clamper	58	18
Refer to the term positive or negative clampers	57	17

Table 2. Examples of Areas of Little Similarity Between Musterings.

16. In point of fact, the general conclusion drawn from the two electronic principles surveys conducted in the RAAF is that there are insufficient numbers of principles employed in common across all nine musterings surveyed to justify a cost-effective common course in electronic principles. However, if no one considers a subset of musterings (for example RADTECHA and RADTECHG, or INSTFITT and ELECFITT), then there may be grounds for common training in some principles. The USAF is currently investigating the possibility of developing a set of common electronic principles courses, each to be attempted by members of certain musterings. With the electronic principles data now available, the RAAF can do the same.

Timing of Training

17. In much of our military training, there has been at least implied the idea that "we only get our airmen for training one time, so let's give him everything we can." There are at least two pitfalls with this approach to the training of airmen. The first has to do with cost, and has already been discussed earlier in this paper. The second is concerned with the basic premise of this philosophy - that airmen are only available for training one time.

18. Should airmen receive only one course of technical training in electronic principles? The answer to this question depends on several factors, but the most important concern should be when the individual is likely, with some substantial degree of probability, to make use of the training. There may be tasks performed or principles employed by large percentages of young airmen shortly after completion of training, and these should obviously receive attention in the basic technical training course. But what about those tasks and principles that are not performed or used by very many lower-ranking people at all, but rather are reserved for use by more senior personnel? Training new recruits in a basic course on tasks and principles that they will not use until much later in their careers is not only expensive (they may exit the service before they get a chance to use the training), but it may be just plain foolhardy, particularly in a highly technical area like electronics. In the first place, there is every likelihood that the individual will forget many technical aspects of training received years before it is needed. And secondly, even if the training is remembered, it may become obsolete before it can be employed.

19. What the above discussion suggests is the possibility of providing new recruits with a basic course in electronic principles which gives them only what they are reasonably certain to need in their first few years on the job. Then, if they re-engage, more advanced training in electronic principles, as well as other technical aspects of their trade, can be given to prepare them for the next several years of their careers.

20. Such a scheme is certainly not appropriate for every trade. However, electronic principles survey data like those presented in Table 3 can be used to determine if sufficient numbers of tasks in areas related to one another fit the pattern illustrated (that is, small percentages of new recruits performing tasks and using principles to larger percentages of more senior people performing tasks and using principles) to warrant a post-graduate type of course. In the first electronic principles survey conducted in the RAAF, respondents from all six technical trades surveyed indicated that some electronic principles training should be delayed for inclusion in a post-graduate course. The question was not posed in the second electronic principles study.

Principle/Task	% Using, AC	% Using, LAC	% Using, CPL
Use or refer to pin insertion or extraction tools	30	52	55
Measure power	25	37	41
Use knowledge of floating reference potential	27	44	46
Adjust transformers	8	20	33
Fault find synchro systems	38	62	61
Operate a valve tester	33	36	53
Operate a frequency meter	17	33	43
Use a knowledge of the ratings of circuit breakers	27	48	54
Use the term conventional current flows	13	36	49
Use a knowledge of the generation of voltage by chemical action	22	41	51

Table 3. Examples of Selected Principles Where Training May Be Delayed in the INSTFITT Mustering

Provided Cost-Effective Training

21. The philosophy behind providing cost-effective training has already been briefly discussed. To reiterate, this philosophy states that training dollars should be concentrated on those skills and knowledges that trainees are most likely to make use of in the period immediately following completion of their training. The length of that period will be a function of several factors such as how technical the trade is, but probably shouldn't extend beyond the first enlistment period.

22. Data from electronic principles surveys provide information concerning those electronics skills and knowledges used by airmen in various groups. Those data can be compared with current training syllabuses to determine areas of overtraining or misdirected training. Once such a determination is made, specific adjustments to existing training programmes can be made, so that electronic principles actually used by airmen in the performance of their jobs are included in training programmes of the future, and so that "nice to know" but little used information is eliminated or postponed for inclusion in a post-graduate course.

23. Table 4 provides an example of how survey data can be used to identify areas of possible overtraining. At the time of the first electronic principles survey, airmen in the Armament Fitter mustering were receiving 15 units of training on inductors, and yet,as can be seen in the table, only very small percentages of airmen in the lower ranks were using these principles or performing tasks associated with inductors.

Principle/Task	% Using
GENERAL AREA: INDUCTORS, TIME SPENT 15 UNITS	
Test inductors (coils)	6
Fault find in circuits containing inductors (coils)	7
Remove or replace inductors (coils)	6
Adjust inductors (coils)	3
Induced voltages in a coil	6
Self inductance in a coil	6
Back emf or self induced voltage in a coil	6
The unit of self or mutual inductance - the Henry	6
The factors affecting self inductance of a coil (eg coil size, number of turns, etc)	6
The method of finding the total inductance of a number of inductors in series and parallel	5
The types of fixed inductors (iron core, iron dust core, air core)	6
The uses of inductors to store energy or oppose current changes	5
The common faults of inductors (eg shorted turns, open circuits, etc)	6
The phase relationship between applied voltage and circuit current for a purely inductive AC circuit	5
The relation $P_{av} = 0$ for a purely inductive AC circuit	3
The graph of X_L against frequency	2
Mutual inductance (M)	3
Voltage rating of inductors	4
Frequency ratings of inductors	3
Current rating of inductors	4

Table 4. Example of Possible Overtraining in the ARMFITT Mustering

24. While an example is not presented here, it is easy to envision a set of circumstances where little or no training is being provided in an area in which airmen are called upon to be proficient when they reach their jobs in the field. Identification of both areas of overtraining and undertaining is essential if training is to be both cost-effective and at the same time effective in producing graduates who are able to perform on the job with little additional indoctrination. The EPI is one tool which can help in the identification of these potential problem areas.

SOME CAUTIONS IN THE APPLICATION OF SURVEY DATA

25. It should be obvious from the above discussion that the EPI can produce data which have broad potential utility in the training environment. At this point, it seems appropriate to introduce a few cautions which must be heeded in the application of those data.

Data as a Tool

26. To begin, electronic principles survey data must not be viewed as a panacea - they do not provide the answer to all our electronics training problems. Rather, they are more appropriately viewed as a tool (and hopefully, a very effective tool) which can be used by experts to assist them in applying their professional skills and experience in making training decisions. Too often, users of survey data have taken the data at face value and have attempted to apply them without regard for extenuating circumstances or special cases. Often the results are of much less utility than anticipated, and the survey technique is blamed for being inadequate or invalid. The numbers do "speak for themselves", but they need someone to talk to - someone who will apply his or her professional judgement in the interpretation and application of the data.

Using Data In Context

27. One of the most dangerous pitfalls in attempting to apply survey data is the tendency to take survey results out of context. In the example cited previously on the use of inductors by members of the Armament Fitter mustering, it is true that very few Armament Fitters use inductors or directly employ any knowledge of inductors. However, before all training on inductors is scrapped, the subject matter specialist must be certain that knowledge of inductors is not essential to the understanding of other principles and/or tasks which are used or performed. Once the specialist is convinced that knowledge of the principles of inductors is not used directly or indirectly, then appropriate steps can be taken to reduce or eliminate training on inductors. The important point is that portions of survey data must be evaluated within the context of all the survey data; indeed, within the context of the mustering and its activities as a whole.

Survey Data and Policy

28. Throughout this paper, it has been necessary to make one underlying assumption when speaking about the uses of survey data in the training environment. The EPI determines what is going on in the field. The examples presented in this paper for the use of electronic principles survey data have been based on the assumption that what is going on in the field is what ought to be going on in the field. Unfortunately, this assumption is not valid in every instance.

There may be areas within a survey where data (what is) and management's policy (what ought to be) are in disagreement. And so, before survey data are applied in any way, those responsible for making and evaluating policy should examine the data to determine if policy is being followed. In those instances where policy and data agree, application of the data to training problems is warranted; however, in those areas where there is disagreement between policy and data, corrective action of one sort or another will be necessary. Either the policy is wrong, in which case it should be changed and survey data can be applied; or policy is validated, and the survey data pertaining to those areas is of no further use, having served the purpose of identifying areas where policy has not been enforced. This procedure of enlisting the aid of policy makers early in the training validation process is essential if we are to avoid perpetuating inadequacies in either policy or performance, or both. And because the policy makers are involved from the start of the training validation process, they are much more likely to be satisfied with the resulting training programme that emerges.

SUMMARY

29. The EPI is a survey instrument which differs from other occupational survey instruments in that it obtains information about knowledges employed on the job as well as tasks performed; and it can be administered to any group of people who work with electronics, not just to members of one trade. It has been developed in a period of rising training costs and increasingly scarce training dollars in an effort to contribute to the development of cost effective electronics training. When employed as a tool by professionals and technical specialists who temper survey data with their own skill and experience, training programmes that are both economical and motivating can result. Those training programmes in turn will produce the very commodity for which they exist: motivated personnel, adequately trained at minimum cost to perform the tasks and employ the principles they will be called upon to perform and employ in their daily jobs.

CONFIDENTIALITY OF DATA IN OCCUPATIONAL ANALYSIS SURVEYS

Major A. Davidson, MA (Ed & Psych)
Military Employments Research Information Team

INTRODUCTION

1. Once having launched into this topic I discovered that the actual heading of this paper should not simply have been "Confidentiality of Data in Occupational Analysis Surveys". The other side of the coin, and very much allied with confidentiality is the question of respondent anonymity or lack there of. If total anonymity is to be decided upon, then confidentiality would follow as a matter of course.

2. The carrying out of surveys, be they for the purpose of gathering occupational analysis data or for any other purpose, usually entails the gathering of data, some of which at least, respondents would not like advertised or to have themselves identified with.

3. As a general rule, in socio-metric surveys, where random samples are used and where follow-up or identification is unnecessary, total anonymity of responses is accepted as a standard operating procedure.

CONFLICT

4. However, when we turn to occupational analysis surveys within the Services, other factors begin to arise. Firstly the surveys are usually aimed at 100% of any group of respondents. Secondly, much more personal information is sought. For a variety of reasons, accurate information is needed on ranks, units, time in service and so on. Also the possibility of follow up studies can exist in specific trades or units.

5. The question (and conflict) thus arises: do we in fact lose reliable data when we insist on having each respondent identify himself to the extent that we are able to trace the completed booklet directly to its source? Will the respondent, knowing that he can be identified, give us answers which he thinks we will be happier with? Or, for that very same reason, will he give us more honest answers? I am speaking here, mainly about the section of the questionnaire booklet which asks personal questions and opinions, such as Job Satisfaction and Intention to Re-engage, rather than that section which deals strictly with the tasks performed.

TOTAL ANONYMITY

6. We in the Army have experienced at least one survey, and a reasonably large one at that, where total anonymity has led to an unacceptably large percentage of incorrect information and

childish filling out of answer sheets. It is possible however that other factors (such as the possibility of insufficient sponsor corps backing or interest) may have contributed.

TOTAL IDENTIFICATION

7. The opposite approach to total anonymity is to ask for all identifying information to be provided. Number, rank, name and unit, and, I believe with the United States Air Force, even a contact telephone number is requested. As I understand, this approach results in acceptable response rates.

8. When a specific question arises concerning a group of tasks and members of a trade, a direct telephone call may be made to clear up any confusion. This I believe is also a method of publicising the work done, and existence of, the Occupational Analysis network.

ARMY APPROACH

9. We in the Army have steered a somewhat middle path. For identification we ask unit and Army Number plus rank. In addition we strongly stress both in introductory letters and the instruction letter accompanying the survey booklet, that the respondents answers will be seen by no-one outside the occupational analysis Section.

10. Our main problem as I see it, is that this confidentiality must not only be observed in practice, but must be seen to be observed by the respondent. To have the (say) Chief Clerk, or Adjutant of any unit getting together and having a quiet chuckle over some respondents efforts, is a certain way to destroy credibility if it becomes common knowledge among soldiers.

11. We have also had experience of respondents' supervisors actually amending the completed booklets in the honest belief that they were doing the right thing.

WHAT'S THE ANSWER

12. Having at one time or another been involved with surveys of almost every type, it would appear to me that the basic goal we must strive for is not so much deciding the scope of personal information we seek, but to ensure that the confidential treatment of that information is made as effective as possible. This confidential treatment must be made obvious to the respondent. He must be able to see that if he does answer honestly and so perhaps in a manner unacceptable to his superiors, his own personal career is totally protected. If we get the soldier to trust us, he will give us information that we can trust.

13. Having such a variety of units in such diverse locations, we are not in a position to use methods so successfully employed by the Air Force. The Navy has two main methods of survey administration. These are somewhat similar to our own. The first method is where members of the Navy Occupation analysis cell actually go out to areas of concentration of members of the trade involved. They distribute, administer, and collect the booklets. The second method is to send bundles of booklets to contact officers in inaccessible areas such as ships at sea, or remote areas such as Darwin. In the areas where the Navy has training research units, these are used as contact points. The Air Force on the other hand uses Presidents of Unit Trade Testing Boards. These personnel are responsible for questionnaire administration at unit level. The majority of Air Force units have these trade test boards. In the few locations where these boards do not exist, unit commanding officers are responsible. This system has the great advantage of insuring that surveys are administered by trained personnel under control conditions. We in the Army are forced to use local distributing and briefing officers, many of whom have the task thrust upon them perhaps unwillingly.

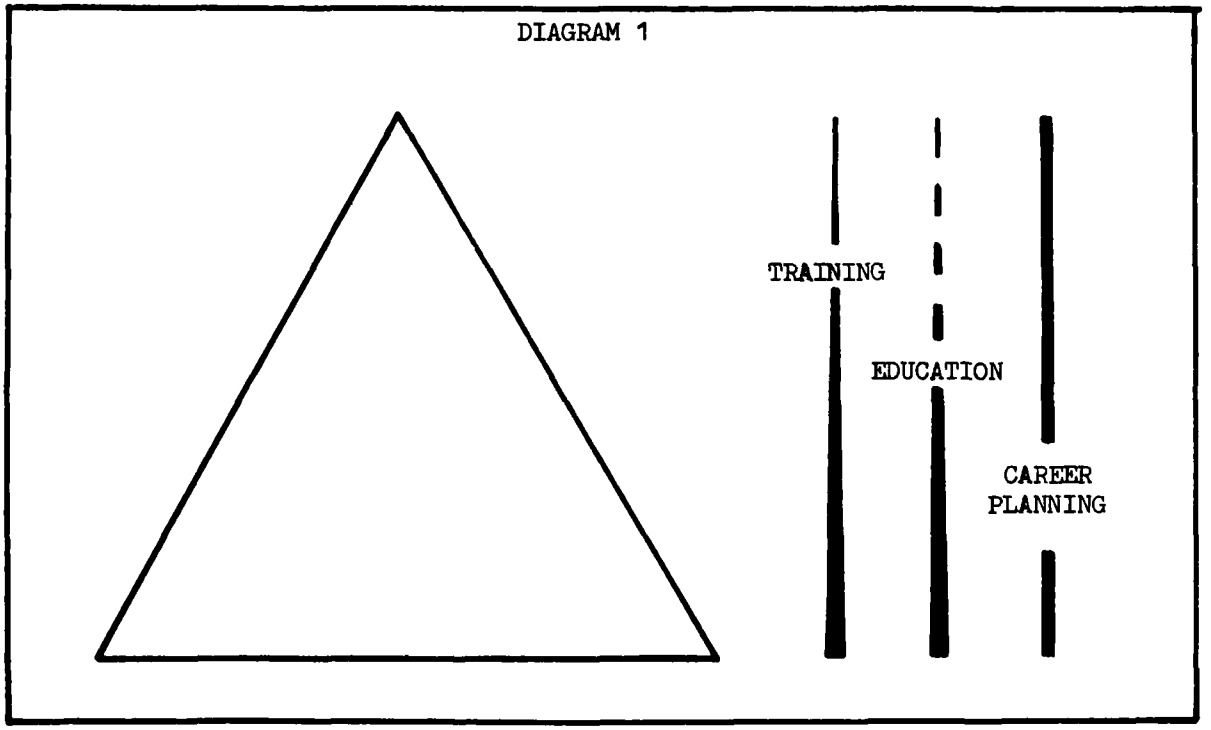
14. Instructions on questionnaire explanation are normally set out in a letter which is never as successful as the personal approach. We should aim at lessening the amount of post survey work for these people. So as I asked before, What is the answer? It would appear then that in the long run our only answer could possibly be the use of individual return addressed envelopes, or in view of comments made thus far by Dr Christal, perhaps this problem is not in fact important.

OCCUPATIONAL ANALYSIS OF RAN OFFICERS

Lieutenant Commander R. Hawketts, BSc, RAN
Staff Officer Occupational Analysis

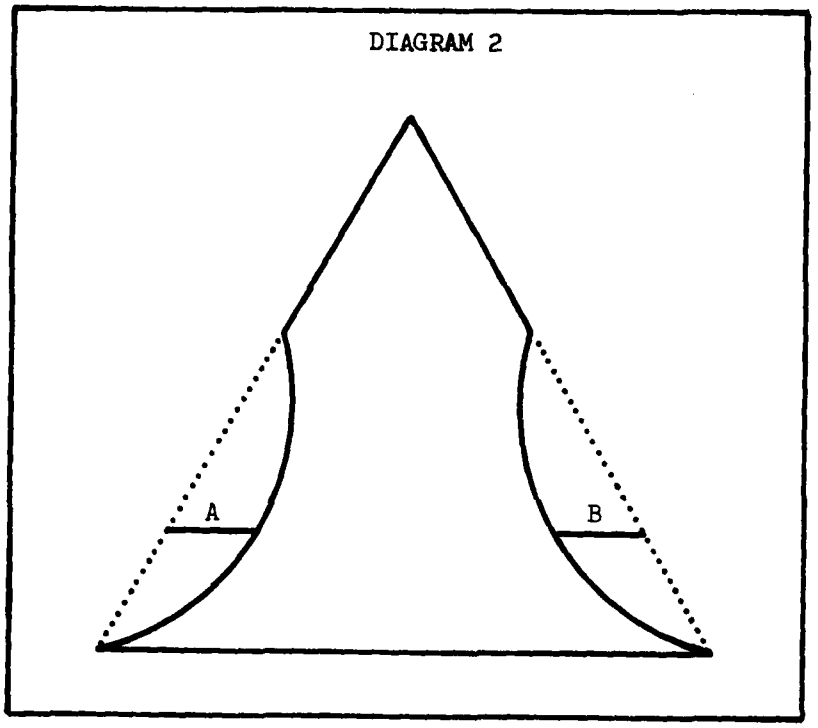
1. Occupational Analysis work in the Australian Services generally, and the Navy in particular, is relatively new and consequently its methodology is heavily biassed towards published research and survey reports from overseas. As in all such work, the best and most obvious return for effort is made in studies covering large population groups, so it is hardly surprising that most of this published work refers to surveys of "other rank" employments. Nevertheless the Officer Corps, although forming less than fifteen percent of the Navy's strength is vitally important to its efficient functioning and I am certain that this applies equally well to any other Military Service. This was clearly appreciated when the Navy's Occupational Analysis Unit was tasked by the Chief of Naval Personnel with a survey to gather information useful in monitoring what was termed "the Officer development process". The integral parts of this process are taken to be formal and Service education, training and career planning. The expression itself and its definition closely matches that used by the Army in its recent Regular Officer Development Committee investigations. Obviously then, the Officer development process is closely related to the career pyramid, and its factors run through rank structure.

DIAGRAM 1



2. Diagram 1 shows the generally accepted ideal career pyramid with the factors of the Officer development process starting at the base with the lowest ranks and (hopefully) running through to the highest. If an Officer's aims and desires are not met by his particular development plan, then there is a danger of him being lost to the Service with consequent changes in the pyramid shape (Diagram 2). The stages at which these changes occur will depend on whether this mismatch is related to rank, branch or domestic circumstances.

DIAGRAM 2



The shortfall in numbers by ranks is indicated by the horizontal distances A and B in diagram 2.

3. The problem of postings is compounded by promotion difficulties at the higher ranks as the latitude for selection diminishes. This may in turn affect the quality of the upper echelon since it would be unwise to assume that only those who would have been promoted in any case, remained in the Service. To regain the optimum pyramid shape, the base can be broadened with consequent increase in training and recruitment costs, and perhaps later different problems if anticipated wastage rates are not met. A further problem here may be that the entry quality standards may have to be reduced to meet the quantitative needs. The alternative is to attempt to cut back on losses by changes in the development process itself. These changes would be the result of Service considerations supported or amended as necessary by expressed opinions, attitudes and aims of the individuals being developed.

4. The second is clearly the more sensible course and the Navy's Survey of Officers is using a questionnaire designed to gather opinion on the range of Officer Development Process Factors, for ranks up to Commander.

5. Table 1 shows the seven sections of the questionnaire, and with the exception of the first, all call for estimates or assessments from the job incumbent.

TABLE 1

RAN OFFICER SURVEY

1. Personal Details
2. Qualities and Skills
3. Opinions of Rank and Branch
4. Job Responsibilities
5. Career Satisfaction
6. Management Organisation
7. Educational Needs

6. Coarse job appraisals are called for in Sections 2, 3 and 6, using different parameters:

a. Abilities - based on the Officer assessment form.

b. Management - using the factors defined in the RAN Duty Statement form.

c. Rank Opinion

Hopefully there will be an acceptable consistency of estimates within the one job, to allow ranking of jobs in terms of one or more of the factors used. It is anticipated that this classification of jobs will allow better matching of men and jobs and, through identification of jobs without branch or specialisation requirements, will give some flexibility in postings.

7. A finer breakdown of the job content is given in Section 4, although this by no means approaches the level of task detail used in "other rank" surveys. The assessments of adequacy of training given for the activities listed, should provide some guidance to trainers, and will at least identify training areas and activities to be subjected to more detailed study.

8. As I said earlier, the ability to plan careers is reduced as wastage increases to the stage where the available manpower leaves no margin for selection in either postings or promotions. It is possible that wastage is equated to a range of Service conditions, financial and others, such as educational or travel

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a. Section 1 - Personal Details.

b. Section 2 - Qualities and Skills.

c. Section 3 - Opinions of Rank and Branch.

d. Section 4 - Job Responsibilities.

e. Section 5 - Career Satisfaction.

f. Section 6 - Management Organisation.

g. Section 7 - Educational Needs.

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opportunities. Section 5 will give a feel for the relative degrees of satisfaction with a wide range of Service conditions and permit comparison of satisfaction levels between branches, ranks and specialisations. The final section will measure the requirement for education subjects within jobs.

9. For this survey over 1900 questionnaires have been issued, one to each established billet. At this stage 62% of the booklets issued have been returned, and we shall establish the first computer file within the next two weeks. The broad intent is to provide directors initially with basic outputs that are considered relevant to their responsibilities, and then to invite direction with respect to more precise information needs.

10. A large number (35%) of the respondents have taken the opportunity to pass to Navy Office their comments on various aspects of Service life and conditions which they felt the questionnaire did not investigate in sufficient depth. These also are being analysed and any further questionnaires will be improved in the light of much constructive comment.

OFFICER JOB ANALYSIS - ARMY

Lieutenant Colonel M.J. Eley, BA, Dip. Ed.

Deputy Director of Psychology - Army

1. I want briefly to describe two surveys that the Military Employments Research Information Team (MERIT) carried out for the Regular Officer Development Committee (RODC) in 1977. Both surveys were conducted on samples of Army Officers and both were in response to specific requests from that committee for objectively derived information on Army Officers.

2. I have subtitled my presentation "The Importance lies in the Grain of Salt", because although I believe both surveys answered most of the questions posed, I also believe the information and its interpretation is subject to specific limitations, mainly because the surveys represent an attempt to apply very objective measures to very unstructured jobs, and employment groups. I hope that Dr Christal during his visit will be able to comment on some of the doubts I will express.

3. The first survey was in response to a question from the RODC which wanted to know the opinions of officers on the relevance of areas of education to appointments, ranks, and career development. We decided to design a survey that almost replicated one conducted by Morsh on USAF Officers in 1969.

4. A list of 122 education topics that might normally not be the subject of formal course training, was developed by a panel of selected officers from a wide range of backgrounds and experience, using Morsh's list as a basis. The topics were grouped as shown in Table 1.

TABLE 1

TOPIC HEADINGS

1.	National Security Policy and Strategy	(Containing 15 Topics)
2.	International relations and Economics	(22 Topics)
3.	Organisation of Military Forces	(9 Topics)
4.	Military Operations	(11 Topics)
5.	Military Technology	(3 Topics)
6.	Military History	(2 Topics)
7.	Joint and Allied Warfare	(5 Topics)
8.	Logistics	(8 Topics)
9.	Management Skills (Individual)	(10 Topics)
10.	Management Skills (General)	(7 Topics)
11.	Management Theory (Leadership and Human Relations)	(6 Topics)
12.	Management Theory (Organisations and Systems)	(9 Topics)

13. Training (5 Topics)

14. General Topics (8 Topics)

5. The 122 topics were included in a questionaire, where for each topic, two questions were asked:

a. Need to Know (NTK)

"Rate the extent to which you consider an Army Officer in general needs knowledge of this topic for effective development in his or her career". (The NTK question was designed to measure the degree to which officers saw a general need for knowledge in that area. A second question was asked in an attempt to measure a more realistic job related to need).

b. Need on Job (NOJ)

"Rate the extent to which you consider an officer of your rank in your present job actually needs knowledge of this topic to perform his or her duties".

6. Using CODAP a variable representing the average numerical response to the NTK at NOJ questions for each topic was calculated, for difference groups selected from the sample. The size of this "average" variable indicated the extent to which that group of officers recognised a need to know that topic, in general, or a need in their own job.

7. Because of time I can't go into detail about the results, but byway of example I shall show a couple of summaries. Firstly, taking NOJ as the most significant measure of actual need, the following ten topics were identified as most needed by the sample as a whole:

1. Written Communication Skills

2. Oral Communication Skills

3. Leadership and Man Management

4. Discipline and Morale

5. Security of Classified Matter

6. Techniques of Logical Thinking

7. Organisation and Role of Functional Commands and Military Districts

8. Role and Employment of the Australian Army

9. Problem Solving Techniques

10. Counselling and Evaluating

It is perhaps no coincidence that the bulk of these topics come from the area of Individual Management Skills. This fitted into what the RODC had been finding out from other areas.

8. Another example, again using mean NOJ, compares the "most needed" topics rated by various ranks:

Second Lieutenant

1. Safety
2. Leadership and Man Management
3. Discipline and Morale
4. How the Army Logistic System Works
5. Written Communication Skills
6. Unit Organisation, Tactics etc
7. Counselling and Evaluating
8. Oral Communication Skills
9. Military Law
10. Health and Hygiene

Junior officers, because of the way in which they are employed, tend to rank Management Theory, Training and Safety etc, highly. As rank increased, Individual Management Skills became more important, and topics from areas such as "Army Organisation and Role", as opposed to "Unit Organisation and Tactics, became also more significant.

Major

1. Written Communication Skills
2. Oral Communication Skills
3. Conference and Committee Techniques
3. Leadership and Man Management
4. Techniques of Logical Thinking
5. Organisation and Role of Functional Commands and Military Districts
6. Role and Employment of Australian Army
7. Problem Solving Techniques
8. Techniques of Creative Thinking
9. How the Army Logistic System Works

9. The RODC in fact asked for printouts showing the top 40 odd topics for each rank, and they were looking for, and found, Confirmation for other findings of theirs in this survey.

10. The second survey was an officer job analysis, a more traditional kind. The RODC wanted to know, the duties and tasks associated with particular ranks, types of appointments and corps of officers. Also, the best way of grouping like officer appointments.

11. For the officer job analysis, Morsh's ideas again were generally followed, but some significant differences were incorporated. Again using careful investigation, and scrutiny by a wide range of Officers, we developed two separate lists of tasks. One was a list of management functions, and these tasks came under the management - oriented headings of:

Commanding and Directing,

Supervising,

Planning,

Organising,

Evaluating,

Coordinating,

Communicating, and

Implementing.

This was the structure used by Morsh. Our other task list was a list of normal, functional tasks, covered by topic headings such as:

Operations,

Drill and Ceremonial,

Policy,

Training,

Discipline,

Personnel Employment,

Personnel Support,

Logistics, and

Army Works, Movements etc.

12. These are the normal functional groups we associate with occupational analysis. But the task inventory didn't contain all tasks performed by all officers. It contained 300 odd tasks selected because they were known, or thought, to be common to many jobs. Because most of the tasks performed by an officer, or for that matter by anyone removed from the strictly controlled man-machine or routine environment are difficult to measure accurately by the normal means, which involves assessing the relative time spent on each task, we used a measurement scale that we believed suited officer type tasks. For each task that an officer performed he responded to this question:

"For each task which you recognise as a part of your job, rate its contribution to your job (in peace or war) on the following scale:"

1. A minor Part of my Job
2.
3.
4.
5. A Substantial Part of My Job
6.
7.
8.
9. A most significant Part of My Job

From this scale, a variable called Average Percent Contribution to Job (APCJ) was extracted for each task and this was the variable which was used most effectively to describe and compare the jobs of officers by rank, type of employment and other categories.

13. But we used two task inventories, and because each task listing in itself described the same range of activities from a different viewpoint it was obvious that to combine the lists when they were analysed would be to mix up and duplicate overlapping tasks. So in effect two separate surveys were conducted together. The different task lists were analysed separately, and interpreted separately, and interpreted separately at first. For the RODC, this was sufficient but for a proper analysis of officer jobs these two series of results were able to be analysed as complementary ways of describing officers jobs.

14. A couple of the results we obtained can be illustrated by the table at Annex A. The measure of the involvement in each duty by each rank level is average percent contribution to job (APCJ). The survey showed that:

a. APCJ declines when rank increases, for, Operations and Personnel Support duties;

b. APCJ peaks at Lieutenant and Captain, for, Training and Discipline duties;

c. APCJ peaks at Captain and Major, for, Logistics and Works, Movement duties, and

d. APCJ increases and rank increases, for, Policy and Personnel Employment duties.

15. This normal functional task inventory was used to extract quite a lot of information about the employment of officers. The CODAP cluster analysis program identified thirty two identifiable groups of officer groups, thereby providing information of some value to the RODC. That committee had also asked us to measure the difference in the employment of certain groups of officers. Among these were Officers commissioned from senior NCO rank (Administrative and Technical Officers), and women. Annex B compares the employment of these two groups against the all officer sample. Predictably, women perform less in the areas of Policy, Training and Discipline, and more in the areas of personnel employment and personnel support. Administrative and Technical Officers, who are usually employed in administrative and Q work, predictably do more in the areas of logistics, works and movement, and discipline, as well as following the women in Personnel Empl ment and Personnel Support. At the task level, some of the specific tasks performed more by women than men were:

a. Personnel Employment

Interview applicants, interview/Counsell and provide personnel information on request,

b. Personnel Support.

Promulgate and explain Service Conditions policy and process applications for allowances,

c. Logistics.

Conduct a stocktake of stores/equipment and amend entitlement documents, and

d. Miscellaneous.

Account for Public Monies.

16. Analysis of the other task inventory, the one categorised by management functions rather than ordinary specific tasks, resulted in a deal of information about who does what in the area of management. One example is at Annex C, which shows, by rank, that:

a. Involvement increases, as rank increases, in the functions of Commanding and Directing, Planning, Evaluating, and Communicating.

b. On the other hand, involvement decreases as rank increases in the functions of Supervising and Implementing.

This showed almost the same tendency as that obtained by Morsh eight years earlier in the United States.

SUMMARY

17. A great deal of data was collected and used in those surveys, and the results made sense, supported much of what was known, and produced some new information about officer jobs that wasn't previously known. It was the first across-the-board comprehensive officer job analysis conducted in this country. In one way it was an effective model for other officer surveys, in other ways it was an opportunity for ourselves and others to learn, and improve this type of survey in future.

18. I was concerned, however, by one aspect of this survey and most of the others in which I was involved while I was with MERIT. There is an occasional tendency for users to grasp information from such surveys, and believe the results, literally, and exclusively. The RODC was fairly sensible in its approach, but others who had access to the data tended to believe that because it was objectively derived, it could not be disputed. I would have thought that it was commonsense for the results always to be applied together with a grain of salt. It is a responsibility of those involved in occupational analysis not to just sing the praises of their technique, but to advise users on its limitations, so that it is used to best effect, and not claimed to be something that it is not. The grain of salt was necessary in this survey for three reasons:

a. The tasks were not representative of <u>all</u> Officer tasks,

b. When some sub groups were isolated in some of the smaller Corps, the small sample size made the results unreliable, and,

c. Officers in the Australian Army don't specialize to the extent that their US counterparts do; their jobs change as new incumbents arrive and depart, and therefore although survey information is known to be accurate at the time of collection, particularly with an officer survey, it goes out of date very quickly, and consequently management decisions relying on survey information must bear this in mind.

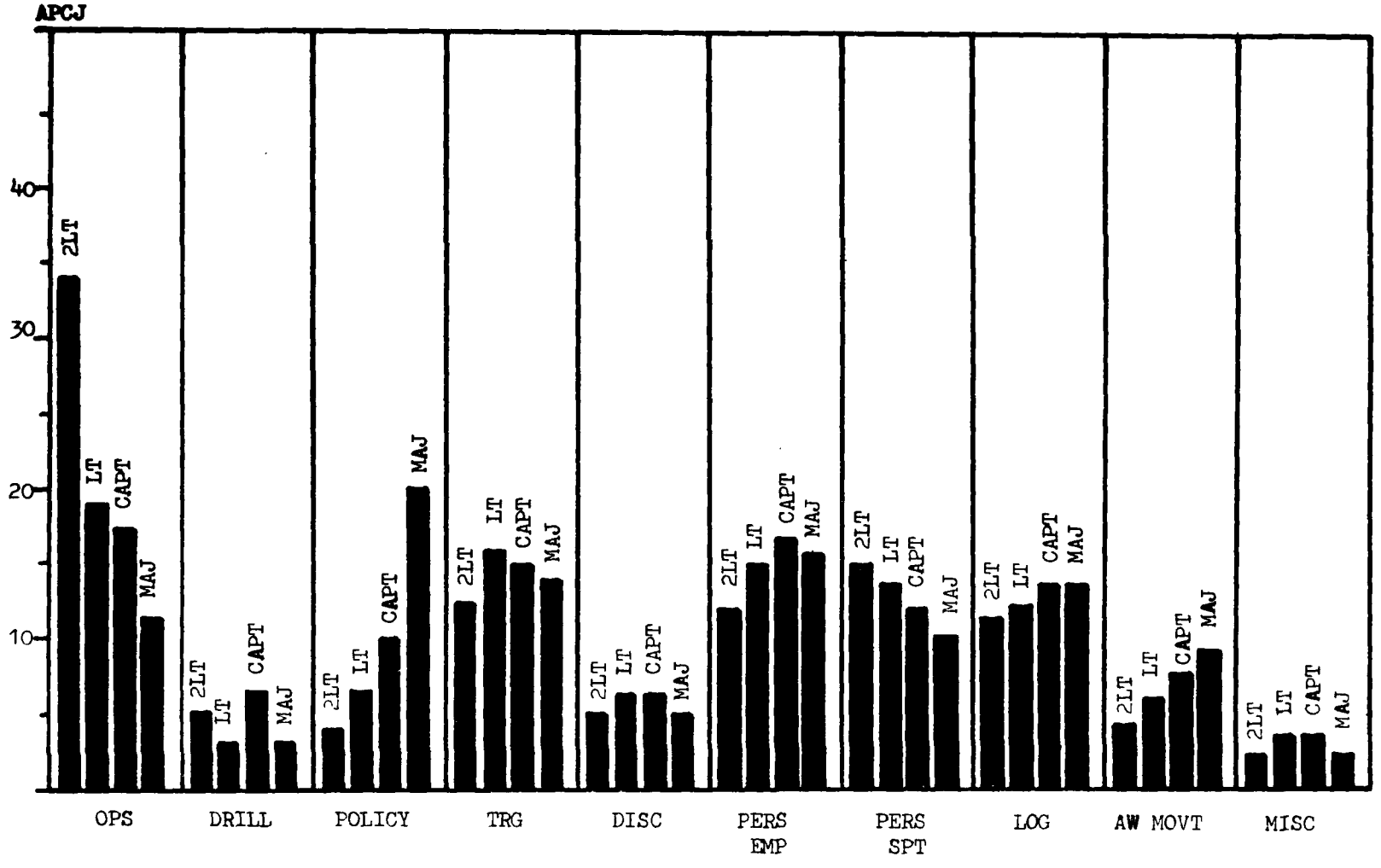
19. Having raised one or two doubts about officer job analysis I would like, in conclusion, to address two questions to Dr Christal, in the hope that the state of the art has advanced far enough in the last two years for him either to be able to answer them directly, or else discuss them during this Seminar.

My two questions are:

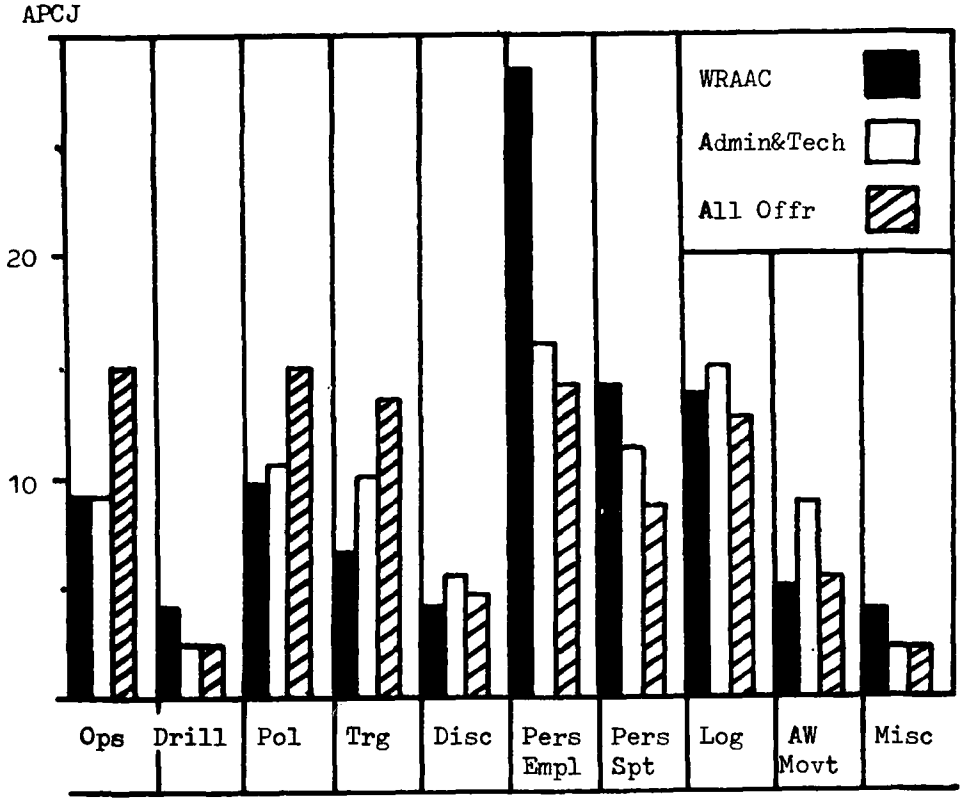
a. To what extent are officer jobs suited to objective job analysis techniques? and secondly, and more generally,

b. Using occupational analysis, how can we effectively measure operational involvement in a peacetime Army?

DUTIES PERFORMED (BY RANK)



COMPARISON OF WRAAC AND A & T OFFRS WITH ALL OFFR SAMPLE



SUMMARY OF INVOLVEMENT IN MANAGEMENT FUNCTIONS BY RANK

	2LT	LT	CAPT	MAJ	LTCOL	T/COL
Commanding & Directing	11	10	10	12	15	17
Supervising	31	26	19	14	11	11
Planning	7	10	12	14	15	16
Organising	3	4	4	4	3	4
Evaluating	6	7	10	12	15	14
Co-ordinating	6	8	7	8	8	6
Communicating	11	12	16	18	16	15
Implementing	9	8	9	7	6	6

RAAF OFFICER EDUCATION AND TRAINING SURVEY

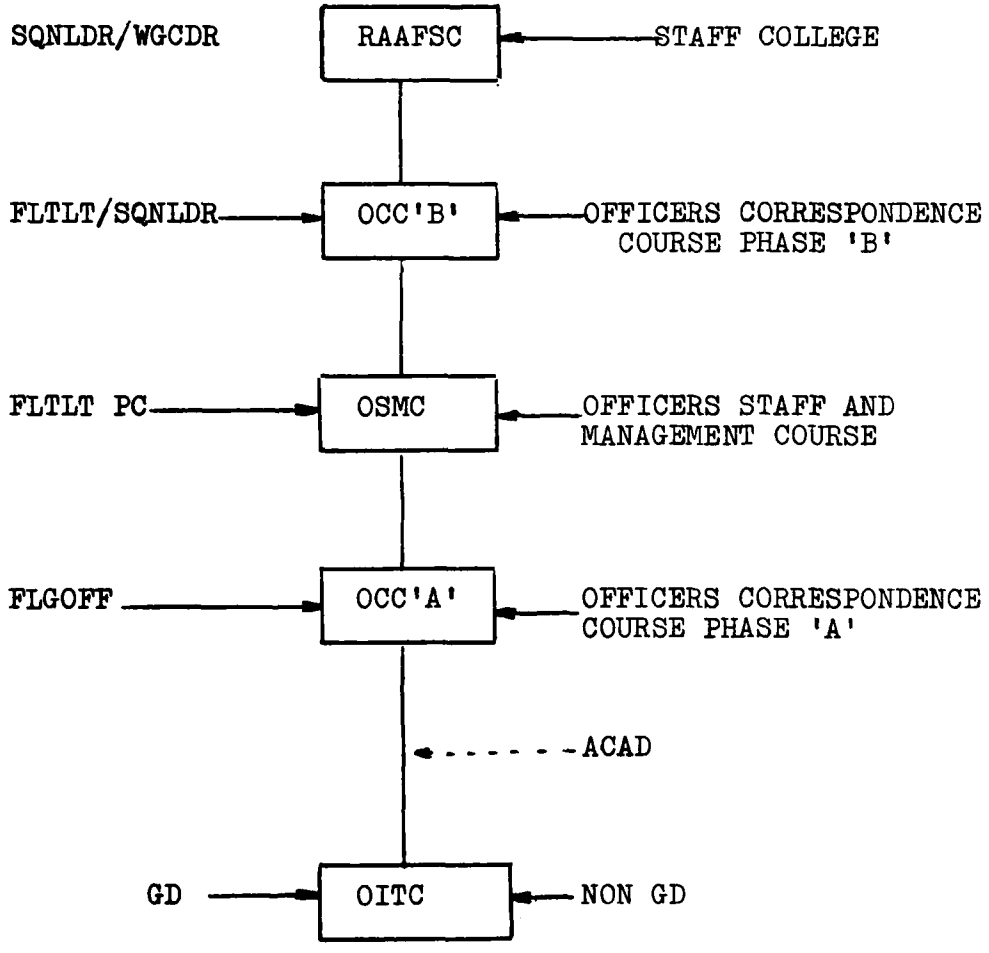
Wing Commander J.T. Huet, BSc, BEd

INTRODUCTION

1. An Officer Education and Training (OET) Design Team, comprising Squadron Leader M.R. Sykes and myself, was established at Headquarters Support Command on 1 March 1979 to review general officer education and training in the RAAF. As a starting point, the team was to assume the OET scheme proposed by the 1973/74 Air Force Office Working Party on officer education and training requirements. The Working Party's proposed OET scheme is shown at Table 1.

TABLE 1

PROPOSED OFFICER EDUCATION AND TRAINING



2. The recommendations of the 1973/74 Working Party have been taken as starting points only for the present review of OET. The Working Party, having been established on a part-time basis, admitted in its report that its findings were based on a subjective analysis; it was not possible in the time available to engage in research of an objective nature to establish training objectives. Thus, there were areas where detailed study needed to be undertaken.

3. Because of the lack of objective data on which to base decisions on OET requirements, the design team's first task was to conduct a survey of RAAF officers to determine exactly what RAAF officers do and what general Service education they require. In particular, the survey was to be used to answer a number of the team's terms of reference (Table 2). The main ones in relation to the survey are terms of reference 1, 2, 3 (part) 4 and 5.

TABLE 2

TERMS OF REFERENCE

1. EVALUATE THE REVISED OET SCHEME AS PROPOSED BY THE 1973/74 AIR FORCE OFFICE WORKING PARTY (IN TERMS OF EFFECTIVENESS OF THE TRAINING FOR PREPARING OFFICERS FOR FUTURE APPOINTMENTS). FORMULATE A BROAD AIM FOR THE PROPOSED OET SCHEME.

2. DETERMINE THE INTEGRATED TRAINING OBJECTIVES (BOTH BEHAVIOURAL AND ATTITUDINAL) FOR THE SEQUENCE OF COURSES.

3. DETERMINE THE BROAD CONCEPT OF EACH COURSE, ITS DURATION, THE NUMBER OF STUDENTS ON EACH, THE APPROXIMATE NUMBER OF STAFF AND SUPPORTING FACILITIES AND THE ANNUAL FREQUENCY OF COURSES.

4. IDENTIFY THE CORE SUBJECTS FOR GD AND NON-GD STUDENTS FOR INITIAL OFFICER TRAINING AND DETERMINE WHERE THESE SUBJECTS WILL BE TAUGHT.

5. IDENTIFY THE NON-CORE OET SUBJECTS FOR BOTH GD AND NON-GD STUDENTS, AND WHERE THESE SUBJECTS WILL BE TAUGHT.

6. EVALUATE THE RODC PROJECT TO DETERMINE WHICH OF THE FINDINGS ARE APPLICABLE TO THE RAAF OET.

7. RECOMMEND THE MOST SUITABLE LOCATION FOR THE OFFICERS' CORRESPONDENCE COURSES (PHASES A AND B) AND THE OFFICERS' STAFF AND MANAGEMENT COURSE.

8. EXAMINE THE NEED FOR SPECIALIST COURSES TO REPLACE SPECIALIST PROMOTION EXAMINATIONS (IF NECESSARY).

9. DETERMINE THE RESOURCES REQUIRED TO IMPLEMENT THE STAGES OF THE REVISED OET PROGRAMME.

10. ESTIMATE THE COST OF IMPLEMENTING THE NEW SCHEME.

11. PREPARE A DRAFT PLAN FOR THE CHANGEOVER FROM THE PRESENT OET SCHEME TO THE PROPOSED SCHEME.

SURVEY ADMINISTRATION

4. To obtain the information required of officers, the team developed a survey booklet. The booklet consisted of three sections, viz:

a. Background Information. Information on the background of each respondent was collected to allow grouping of respondents and comparison of these groups. Examples of background information collected are:

(1) Rank.

(2) Category.

(3) Current Employment.

(4) Number of Immediate Subordinates.

(5) Number of Persons For Whom Responsible.

(6) Job Title.

(7) Unit.

The use of these factors will be explained later.

b. Task Inventory. The task inventory section contained a comprehensive list of general administrative and managerial tasks that officers are likely to perform. The tasks were listed under headings which could be used later for subject headings in course syllabuses. The headings were:

(1) Written Communication.

(2) Oral Communication.

(3) Drill and Ceremonial.

(4) General Administration.

(5) Counter Intelligence.

(6) Personnel Administration.

(7) Secondary Duties.

(8) Planning.

(9) Organizing.

(10) Discipline.

(11) Training.

d. Educational Topics Inventory. The educational topics inventory contained all the educational topics currently taught to officers plus many others that the team determined may be required by officers. The educational topics were also listed under a number of headings as shown:

(1) General Service Knowledge.

(2) General Management.

(3) Australian Government.

(4) International Affairs.

(5) Defence Management.

(6) RAAF Management.

(7) RAAF Operations.

(8) Military and Naval Operations.

5. The survey was administered to a 40 percent sample of RAAF officers in the ranks of PLTOFF to GPCAPT during May 1979. In all, 1230 respondents completed the survey and the data obtained from these respondents were used for analysis.

SURVEY ANALYSIS

6. The task inventory data were analysed firstly by a CODAP programme called DIAGRAM which, as the name implies, produces a computer printout in the form of a diagram. The diagram is shown at Annex A. The programme grouped officers into functional groups based on the similarity of tasks they perform. The background information mentioned earlier was used to identify the various groups. From the diagram, the following conclusions can be drawn:

a. Senior officers perform a different set of tasks from junior officers although there are some tasks that are contained in each set.

b. Officers have grouped according to:

(1) Rank.

(2) Category.

(3) Number of subordinates.

(4) Current employment. (eg, staff officers have grouped separately from unit operatives).

c. One third of RAAF officers do not have any subordinates. The categories in which junior officers are unlikely to have subordinates are General Duties Branch categories of pilot, navigator, air electronics officer, Air Traffic Control and Air Defence.

7. From a training standpoint, the diagram indicates that there are different training requirements for:

a. junior officers without subordinates (unit operatives or instructors);

b. junior officers with subordinates (unit flight or section commanders);

c. flight lieutenants and squadron leaders in staff appointments; and

d. senior officers who are commanding officers, squadron commanders in large units or staff officers.

Computer printouts of the tasks performed by the various officer groups have been obtained.

8. The question now arises: How does the OET design team use this information to determine officer education and training needs? Ideally, the RAAF Directorate of Personnel Officers (DPO) should be able to plan all officers' careers. If this was the case, then officers could be trained appropriately just prior to their being posted to a particular appointment. However, while ideal, the level of career planning required is difficult to achieve in practice. Therefore, instead of providing training for each officer as required, the team had to identify times in terms of ranks and seniority within ranks at which training was appropriate for a significant percentage of officers. We have determined a set of courses and training programmes which, we believe, will provide the RAAF with an effective and progressive officer education and training programme. Since the team's report has not yet been finalised, the proposed new scheme cannot be discussed in detail; suffice to say that it is similar in concept to the 1973/74 Working Party scheme but that it differs in types of training, timing of training and course content.

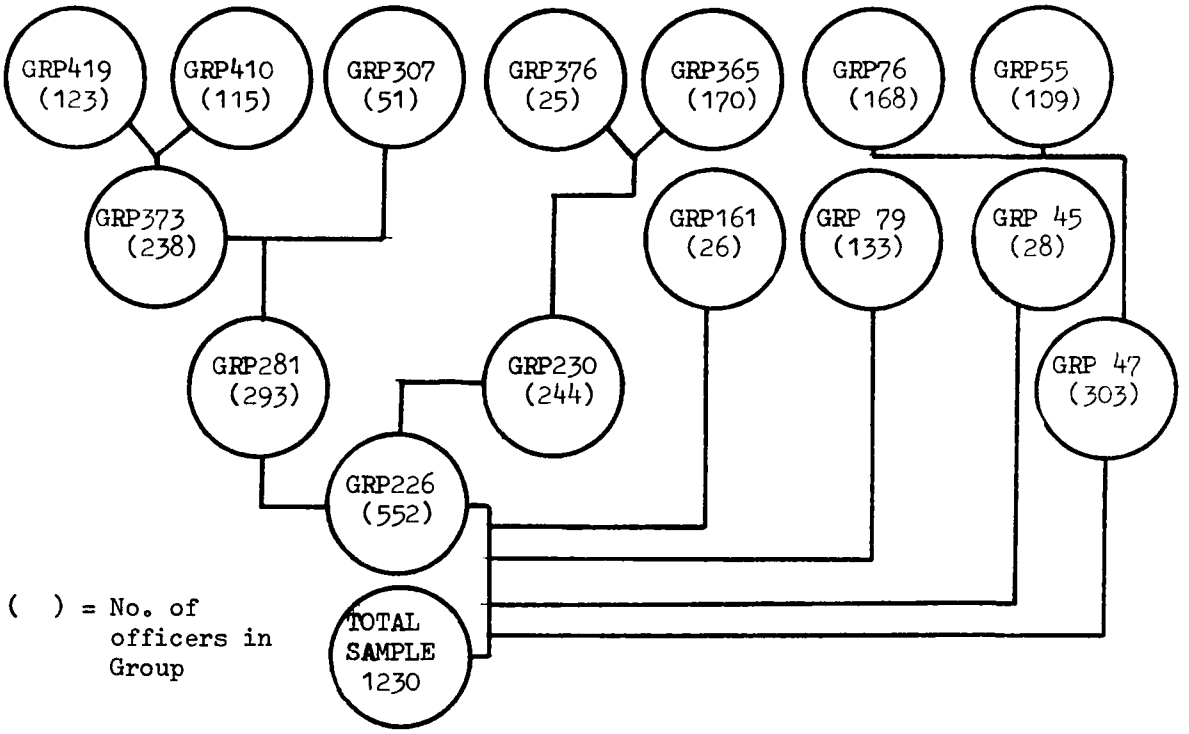
9. Having determined the most suitable training programme, we then determined what tasks should be trained at each level. This has been done by using a Factor Summary (FACSUM) printout, a sample page of which is shown at Annex B. As an example, Task 1 - Write Official Letters - is performed by a high percentage of all officer ranks. Therefore, training should be provided at the officer initial training stage. Also, since the percentage of officers performing the task increases at squadron leader rank, consolidation of that task should be provided at the senior flight lieutenant level. A similar process was carried out for the educational topics inventory.

10. The FACSUM printout was not the only information used to determine when training should be conducted. There are many other CODAP programmes which we have used to clarify what tasks should be taught and when. There is insufficient time to discuss them all. I can, however, mention one particular programme of considerable use in determining the training of tasks. Senior officers were asked to rate each task in the task inventory in terms of the difficulty of learning the task on a 1 to 9 relative scale. From the programme printout we obtained the relative difficulty of each task as rated by over 400 senior officers. The ratings were then used to help determine whether the training given for a task was formal, correspondence or on-the-job.

CONCLUSION

11. The officer education and training survey has provided the design team with the objective data on which an effective programme can be produced. The survey has enabled the team to determine what training is required and when that training should be given. However, the survey cannot, nor should it, provide all the answers for the design of an officers education and training programme. There are a number of subjective assessments that have to be made separately: for example, the philosophy of initial training for junior officers - indoctrination or orientation; high or low pressure course etc. The objective data, though, has formed the basis for the development of what we believe will provide better education and training of RAAF officers in the future.

RAAF OFFICER EDUCATION AND TRAINING SURVEY - TASK DIAGRAM



Description of Groups

GRP 419 Senior staff officers (SQNLDRs, WGCDRs, GPCAPTs) at Air Force Office or Commands.
GRP 410 Senior officers (SQNLDRs, WGCDRs, GPCAPTs) who are commanding officers or squadron commanders in large units.
GRP 373 Amalgamation of GRP 419 and GRP 410
GRP 307 Mainly SQNLDRs in unit flight commander appointments
GRP 281 Amalgamation of GRP 373 and GRP 307
GRP 376 Mixed ranks mainly equipment officers in command staff appointments.
GRP 365 Mainly FLTLTs who are unit section or flight commanders.
GRP 230 Amalgamation of GRP 376 and GRP 365
GRP 161 WGCDRs and SQNLDRs of GD/INTEL Categories in operations related staff appointments.
GRP 79 SQNLDRs and FLTLTs who do not have subordinates in staff appointments at Air Force Office or Commands.
GRP 45 FLTLTs, mainly nurses in unit operative posts without subordinates.
GRP 76 Junior officers of GD/ATC Categories in unit operative posts without subordinates.
GRP 55 Junior officers of GD/ATC/ED Categories in instructional posts without subordinates.
GRP 47 Amalgamation of GRP 76 and GRP 55

ANNEX B to

RAAF OFFICER EDUCATION AND TRAINING SURVEY

TASK	TITLE	ALL O<5 (M)	NON GD<5 (M)	GDO O<5 (M)	FLT O<2 (M)	FLT 2-4 (M)	FLT <4 (M)	SQN LDR (M)	WG CDR (M)	GP CAPT (M)
1.	WRITE OR DRAFT OFFICIAL LETTERS	66.1	73.7	40.9	67.1	68.8	70.0	97.4	98.1	100.0
2.	REVIEW AND SIGN OFFICIAL LETTERS	30.2	38.6	2.3	31.1	32.5	26.9	77.4	88.7	100.0
3.	WRITE OR DRAFT DEMI-OFFICIAL LETTERS	55.6	60.1	40.9	56.7	55.0	55.0	82.1	94.7	100.0
4.	REVIEW AND SIGN DEMI-OFFICIAL LETTERS	28.3	34.8	6.8	24.4	26.9	21.2	66.4	80.8	94.9
5.	WRITE LETTERS OF CONDOLENCE	7.1	8.9	1.1	7.9	7.5	6.3	10.2	27.8	56.4
6.	WRITE DRAFT MEMORANDA	82.4	86.0	70.5	81.1	83.7	86.2	96.7	94.7	79.5
7.	REVIEW AND SIGN MEMORANDA	64.3	74.4	30.7	67.1	67.5	63.1	93.1	88.1	79.5
8.	WRITE PERSONAL AIDS MEMOIR	18.1	21.8	5.7	20.1	21.2	25.0	55.1	65.6	79.5
9.	WRITE OR DRAFT MINUTES	87.7	89.8	80.7	89.0	89.4	95.6	92.3	89.4	76.9
10.	REVIEW AND SIGN MINUTES	71.1	80.2	40.9	72.6	66.9	68.1	90.5	92.7	94.9
11.	WRITE NOTES OF ACTION ON CORRESPONDENCE	77.2	86.7	45.5	78.7	81.3	86.9	98.9	98.7	97.4
12.	DRAFT MESSAGES	87.4	85.3	94.3	84.1	88.1	95.0	96.4	97.4	94.9
13.	RELEASE MESSAGES	57.7	66.2	29.5	56.1	58.7	63.7	93.8	96.0	100.0
14.	WRITE SERVICE TELEGRAMS	17.6	18.8	13.6	18.9	15.0	25.0	25.5	34.4	38.5
15.	WRITE SERVICE PAPERS	21.0	23.5	12.5	28.0	35.6	38.7	79.6	88.7	89.7
16.	REVIEW AND COMMENT ON SERVICE PAPERS	13.9	17.4	2.3	15.2	21.2	14.4	65.7	86.8	97.4

RELEVANCE OF OCCUPATIONAL ANALYSIS TO MILITARY TRAINING

By Dr R.E. Christal

CODAP STUDIES RELATED TO TRAINING

1. There are a number of questions which need to be answered in order to establish an effective training course: What should be trained? How should they be trained? Where should they be trained? When should they be trained? Most training research during the last few decades has been directed toward the "How" question. Research on training methods is important; but the quality of instruction makes little difference if course content is not responsive to job requirements. Data collected with occupational surveys and analyzed with CODAP can provide direct information for specifying course content, and can be useful in determining when training should be given in order to be timely. Occupational data also can be analyzed to answer specific questions posed by training managers. Today, I will summarize a few studies we have conducted to address management questions, and then, I will describe a more systematic research stream designed to provide a technology for determining the content of entry -level training courses.

MISCELLANEOUS CODAP STUDIES RELATING TO TRAINING

2. In most Air Force occupations, all personnel attend a residence training course before being assigned to their first job. However, there are a few occupations in which only a subset of individuals are taught in residence courses, while the rest are given formalized training at their first job location. A question was posed concerning whether training in the two settings was in fact equivalent in terms of the skills acquired by the recipients. It was not possible for us to measure skills directly, but we could compare the two groups in terms of performance evaluations and the difficulty of work inherited. We hypothesized that those taught in the job setting would be assigned the more challenging tasks until those arriving from the resident schools were better known. However, we felt that if the resident schools provided better training, the superior skills of school graduates would eventually be recognized and reflected in their job assignments and performance ratings. Analyzing data with the CODAP system failed to show significant differences between the two groups at any point in time. A simple analysis, such as this, laid to rest uneasy feelings that those trained in the operational setting were being short-changed.

3. The Inspector General in charge of the Air Force Safety Program wanted to know if occupational survey data could be analyzed to help him determine where additional training on safety practices should be introduced. He had data files containing information on all significant accidents which had occurred during the previous two-year period. Using these

data, we were able to determine the number of accidents occurring in connection with each task in an occupation. Then we set about to develop an equation to predict accidents. Eventually, we were successful in predicting past accidents with an equation which included hazard ratings collected from supervisors, the number of individuals performing each task, and the time spent performing each task. Applying this equation, we were able to predict the accidents which had occurred. However, the predicted scores also identified many tasks with hazard potential on which accidents had not occurred. We will hold these data for two years and see how well the equation predicts future accidents. If it proves valid, it will be used to guide safety training programs.

4. Most of you are aware that the CODAP system is normally used to analyze jobs which are defined in terms of the time workers spend on tasks in their jobs. However, CODAP is a very flexible system, and it can be applied to other types of questionnaire data. For example, the CODAP system was used to analyze the electronic principles claimed to be used by workers in Air Force electronic maintenance occupations; it was used to analyze the need expressed by officers for instruction on professional education topics; it is presently being used to analyze the utilization of knowledges gained by scientists and engineers in previous academic courses; and it was used to analyze ratings by pilots on the utility of simulators for training various flight activities. In each of the above studies, the data were used for determining the content of courses or specifying job requirements.

5. During the Vietnam-Thailand conflict, there was a question as to whether the Air Force special operations course should be expanded. This course covered such activities on counter-insurgency, unconventional warfare, and civic actions. Before the decision was made, HQ USAF asked that a special survey be conducted to determine the extent of Air Force participation in such activities. We built a very comprehensive task inventory, but our main difficulty was in locating individuals performing special operation tasks, since they were not specifically identified by occupational code. Our findings were that most of these activities were being performed by Army personnel, and that the Air Force had a very low level of participation. As a matter of fact, very few of the special operations course graduates were utilizing their skills in this area. The data provided a clear basis for decision.

6. You may be interested in knowing that we conducted occupational surveys in Vietnam and Thailand throughout the period of conflict. The resulting data were used for many purposes, but one study, in particular, may be of interest tc you. We were asked to evaluate whether our training courses, which were designed for a peacetime environment, had prepared our personnel for the types of tasks they encountered in the combat zone. In addition to the routine administration of job inventories, we interviewed hundreds of returning NCOs concerning the work tasks which their subordinates were unprepared to accomplish. In almost every occupation, there were some tasks for which training had not been provided.

Some of the tasks were important; other tasks were not. Loadmasters had been trained to load and unload almost everything except ice and cattle, which were often moved in Vietnam. The weather people knew how to make weather forecasts, but they did not know how to set up weather stations. A number of operations had become dependent on centralized computers which were not available in the combat zone. Only the old hands had the knowledge to revert to manual procedures. In the administrative area, the people did not know how to write money orders or separate mail for shipment, because these activities had been civilianized. But despite some problems in almost every occupation, the general conclusion was that what Air Force people did in Vietnam was not very different from what they did in peacetime in the United States. Some individuals had to be quickly cross-trained to shortage areas, such as munition loaders, but the tasks within occupations were essentially those for which individuals had received training.

7. We presently are helping the Air Force develop and test a new on-the-job training program. At the present time, supervisors vary in the amount and type of training they give their subordinates. The goal is to provide guidance and procedures that will assure workers will receive thorough training on critical tasks. We are presently analyzing occupational data with the CODAP system in a sample of specialties to identify the tasks in each job type, and those cutting across job types, which should be classified as critical.

8. The USAF operates a very large program for retaining individuals into new occupations. Approximately 10,000 to 20,000 such actions occur each year, due to a variety of causes. Some are retrained because they fail an entry-level course; some because they are promoted into an overage status; some because they are needed in a new weapon system; some because they want to reenlist in the Air Force, and there is no room for additional second-term personnel in their occupation. We have been asked to find out how well individuals do in their second occupation. In one study, we located occupational data on 18,000 airmen who had been cross-trained. We were able to demonstrate that there was very little difference between the retrainees and those in their original occupation on variables such as utilization of talent, job interest, and career intentions. However, we were able to show that in some occupations, when months of military service was held constant, the retainees were behind in terms of grade achievement, number of subordinates supervised, and difficulty of work inherited. These differences were significant, but not large.

9. In a second study on retraining, we have data on 40,000 cases who were retrained between 1973 and 1977. Some of the findings are a little surprising. In academic achievement, cross-trainees did better in the entry-level course than those who were being trained for the first time (holding aptitude constant). The more service an individual had when he went

into the course, the better he performed; therefore, the people who retrained in mid-career actually did better than those who were retrained in the first four years. Individuals who had been retrained from a mechanical area to another mechanical area performed better than people who had come from the administrative or general areas. In general, people who trained in the same aptitude domain performed better than those who came from other domains. The one exception was that individuals from electronics AFSs did better in retraining courses than all other groups, including new accessions. This is probably because only individuals with excellent learning abilities tend to get thru electronics course training. A significant question to be answered in this study concerns the number of points on aptitude scores that can be waived for cross-trainees. We found that a 10-point waiver was really quite conservative and, in many cases, you could waive as many as 20 points for retrainees to have equal probabilities of succeeding.

TRAINING COURSES FOR ENTRY LEVEL PERSONNEL

10. Thusfar, I have briefly described a number of short-term studies related to training which made use of occupational information. Now, I would like to describe how this information has and is being used in the Air Force to determine the content of entry-level training courses.

11. For a number of years, we simply delivered CODAP analyses outputs to the training schools for them to use as they saw fit. These reports contained task level job descriptions indicating the percent of first-termers performing each task, which we felt could be used to eliminate deadwood from courses and to determine training emphasis. They also contained information on task difficulty levels, job-type analyses, summary data on tools and test equipment used, group summaries, and many other outputs. However, these computer printouts looked so complicated that there was a strong tendency for the trainer to become confused and not use the information. Also, if no one was complaining about a course, there was no urge to change it. I think it is essential that trainers become ego involved with the whole process of developing the inventory and collecting the data. You cannot just deliver the computer output and expect them to use it. On occasions, we found almost unbelieveable discrepancies between training courses and what was happening on the job. For example, in one career development course, 25 percent of the course content was on tasks that were not being performed. Yet, the course was not changed, even though the school had access to the CODAP report. We finally called the problem to the attention of management, and the course was modified.

12. After several experiences like this, HQ Air Training Command (ATC) established guidance for the use of occupational survey data in the design and modification of courses. If over 50 percent of the workers in an occupation perform a task

in their first assignment, then all would be trained to full proficiency on the task; if between 30 percent and 50 percent perform it, then all would be trained to a point where they could perform the task under close supervision; if fewer than 30 percent perform it, then training would be limited to providing general information about the task. The guidance allowed for exceptions when justified, and it was a good thing it did. There are a lot of reasons why many tasks should be taught even though fewer than 30 percent of the people perform them. On the other hand, there are tasks which 90 percent of the people perform which do not need to be included in a training course, because they are so simple. Eventually, ATC asked us to conduct research on a systematic method of establishing task training priorities for entry-level training courses. First, we looked for factors that needed to be considered. The trainers gave us some useful suggestions. Eventually, we produced a set of factors hypothesized to be relevant as follows:

a. probability of encountering a task;

b. consequences of inadequate performance;

c. probability of inadequate performance;

d. perishability of skills;

e. task difficulty;

f. need for emergency performance;

g. trainability of skill; and

h. cost-effectiveness of residence school training.

We found that some tasks with low probability of performance had to be taught because of the high consequences of inadequate performance. Examples are mouth-to-mouth resuscitation and external heart massage. Although the probability of performing such tasks during a first enlistment may be only one in a hundred, the consequences of inadequate performance is severe. Consequences are measurable in terms of loss or damage to equipment and the loss of life. When probability of inadequate performance is high, a task should be included in a curriculum. When the perishability rate of a skill is high, training should not take place until the skill is actually required. Task difficulty is concerned with the amount of time required to learn to perform adequately. Originally, we had the concept of emergency performance because in some situations you do not have time to find out how to perform a task. With regard to trainability, we knew that there were some skills, such as verbal communication skills, that were not a matter of training but a matter of selection. Finally, we tried to determine the cost-effectiveness of training tasks in residence courses. Well, we collected data on two occupations using those factors and did some regression analysis. We found that we could obtain reliable measures on all the factors, but there were some interesting redundancies. Task difficulty and skill perishability were almost synonymous. The more difficult a

task, the faster the skill perishes. So we felt that we did not need skill perishability as well as task difficulty. The paradox is that the very things that are the most difficult are going to perish the fastest, and this makes the training decisions even tougher. Also, in many instances, task difficulty is almost synonymous with the probability of inadequate performance. The need for emergency performance proved to be a bad factor. People were confused as to whether the task itself was an emergency or whether it took place in an emergency setting. For example, we got high ratings on tasks like directing traffic at the scene of a fire. However, the most consequential problem was associated with the cost-effectiveness of training a residence course. People could not agree as to whether training should be on-the-job or residential, even though there was no disagreement about the need to train for particular tasks. The lesson we learned was that first you determine the priority of teaching a task for entry-level people. When that question is settled, you decide whether it should be taught on-the-job or in resident school.

13. Eventually, we reached the point where we had the following four factors:

a. probability of encountering a task;

b. task delay tolerance;

c.

c. task difficulty; and

d. consequences of inadequate performance.

The first factor, probability of encountering a task, is reflected in the members performing column on the job descriptions. The second one is task delay tolerance; there are certain tasks which, when encountered, must be performed at once. Otherwise, the opportunity rapidly passes. A lot of medical tasks are of that type. This is an important factor because, with many tasks, people must be ready to perform them at any point in time. The third and fourth factors were retained from the original list. Our goal was to develop a single equation which would combine these factors into a composite indicating task training priorities for entry-level courses. Using instructors' and supervisors' ratings as criteria, we developed equations in 30 occupations. Our hope was the standard score weights for the predictor variables would be highly similar in all occupations so that we could define a single equation. Unfortunately, the weights across occupations were not constant. We also began to recognize that, even if we had a good composite equation, it would be difficult to apply. It would require obtaining supervisory ratings on four factors for 400-800 tasks in every occupation. Based upon past research, we knew that any supervisor should not be asked to rate tasks on more than one factor. Thus, we needed 200 raters in each occupation to implement the system. For a number of occupations, this was more than existed. Finally, we gained insight into a simpler and yet highly defensible approach. In about 80 percent of the occupations, we had data indicating there was a very high inter-rater agreement

among supervisors concerning task training priorities. Furthermore, we could demonstrate that these recommendations were based upon consideration of factors with high face validity (probability of performance, consequences of inadequate performance, task delay tolerance, and task difficulty). Where there was high inter-rater agreement among supervisors concerning training priorities, these factors correlated in the 90s with training recommendations. Thus, it looked like we had an acceptable system. We could simply collect direct recommendations of supervisors concerning training, and we could defend those recommendations by our research. But remember that I am referring to about 80 percent of the Air Force specialties. With the remaining 20 percent, there is a special problem. There are the specialties where we do not obtain agreement among supervisors as to what should be trained. We have hypothesized that the primary reason for the disagreement stems from the gross differences in the work performed in the various Air Force commands. The supervisors are rightly pushing those tasks which they have been experiencing during their careers in their own commands. If that is the case, we may end up with an output that shows the recommended training emphasis for every task by command groupings. With those tasks on which everybody is in agreement across commands, we will develop a core curriculum. For tasks unique to certain commands, special courses or OJT may be needed. But, at this stage, that is still a hypothesis.

14. Another matter of concern is whether we should train on what people are doing or on what they should be doing. After looking at a lot of data from many occupations, my personal opinion is that people in the Air Force are doing what has to be done (and if you eliminate the combat arms in the Army, I think the same thing would be found true). People repair aircraft because they break down, and cooks prepare meals because people have to eat. However, I would agree that occasionally the occupational data tell us that people are not doing what they should be. You do not stop training on a task just because people are not performing it, especially if they should be. For example, in the preventative medicine area, one person at each Air Force Base was supposed to make a series of tests to protect the health of the community. A survey showed that no one was performing a particular test. An investigation revealed that the task was not being done because people did not know how to do it. Now, if you were blindly using the data, you might say that no training was required, which is as far from truth as you could get. Another good example is in the equipment operator area. We discovered that people were well trained to operate all types of equipment, but what they actually did was mow the grass, water the flowers and shovel the snow. This occurred because the Air Force was contracting jobs out or letting the civilian employees do the more difficult jobs, and the airmen were doing the leftovers. In this case, there was nothing wrong with the course. If the Air Force wants an equipment operator capability, then it will have to change the job, not the course. In another example, we found that a large number of supervisors in Medical Administration were recommending that more training be given in filling out certain types of forms.

Now, if you looked at the task inventory output, you find that very few people at the junior level are filling out those forms. I think the supervisors were trying to say that they had more important things to do than fill out forms, and they wanted to delegate those tasks down to the junior airmen.

15. Large scale cuts in training budgets have often led to difficult decisions concerning cuts in training courses. In the past, about the only thing that could be done was to ask each course to take its fair share of the cut. Recently, the Air Force Training Command received a multi-million dollar cut in budget, and this time it was decided that occupational survey reports would be used for decisions concerning reductions in training. Even old survey reports were dusted off and used for the occasion. While the occupational survey data were used to make decisions concerning the course reductions, they were not responsible for the cost savings. The cost savings were due to the budget cut. However, we learned a lot from this exercise concerning how survey data should be organized to make them more useful to trainers. We now provide a single CODAP report which is specifically designed for course review. Each task statement appears only once, with training-relevant information printed beside it. The tasks are organized into blocks using a "mapping process" by which tasks in an inventory are "mapped" into the present course outline. The tasks associated with each block of instruction appear together, ordered in terms of mean training emphasis ratings from field supervisors. Also presented are data on other factors, such as task difficulty and percent of first-termers performing. Tasks which are not covered by the present course of instruction are listed at the bottom of the report, ordered in terms of mean training emphasis recommendations. Each course is reviewed by a team made up of course personnel, representatives of the using commands, and the occupational analyst who conducted the survey. The analyst spends most of the first session describing to the review team how the survey was conducted and how the values on the CODAP report were derived. The team then reviews the entire course of instruction using the CODAP report and makes recommendations concerning course modifications. Sometimes, these recommendations lead to lengthening the course in order to accommodate important training not covered. At other times, it leads to course reductions through the elimination of training not being utilized. In all instances, reviews have led to substantial course modifications through a shifting emphasis in accordance with field recommendations reported in the CODAP output. We believe that this team approach, using the revised CODAP output, has improved the utilization of occupational data by trainers by an order of magnitude.

CODAP DATA FORMATS

Squadron Leader D. Thomson, BSc, DipEd
Computing Services Division

1. The aim of this paper is to show and describe some of the main computer outputs that analysts and management personnel see and use. CODAP, as the Australian Defence Force knows it, currently contains over sixty general and special purpose programmes.

2. Table 1 shows the general areas of programme operation. What is not shown are the names of the programmes that fall into each area.

THE CODAP SYSTEM

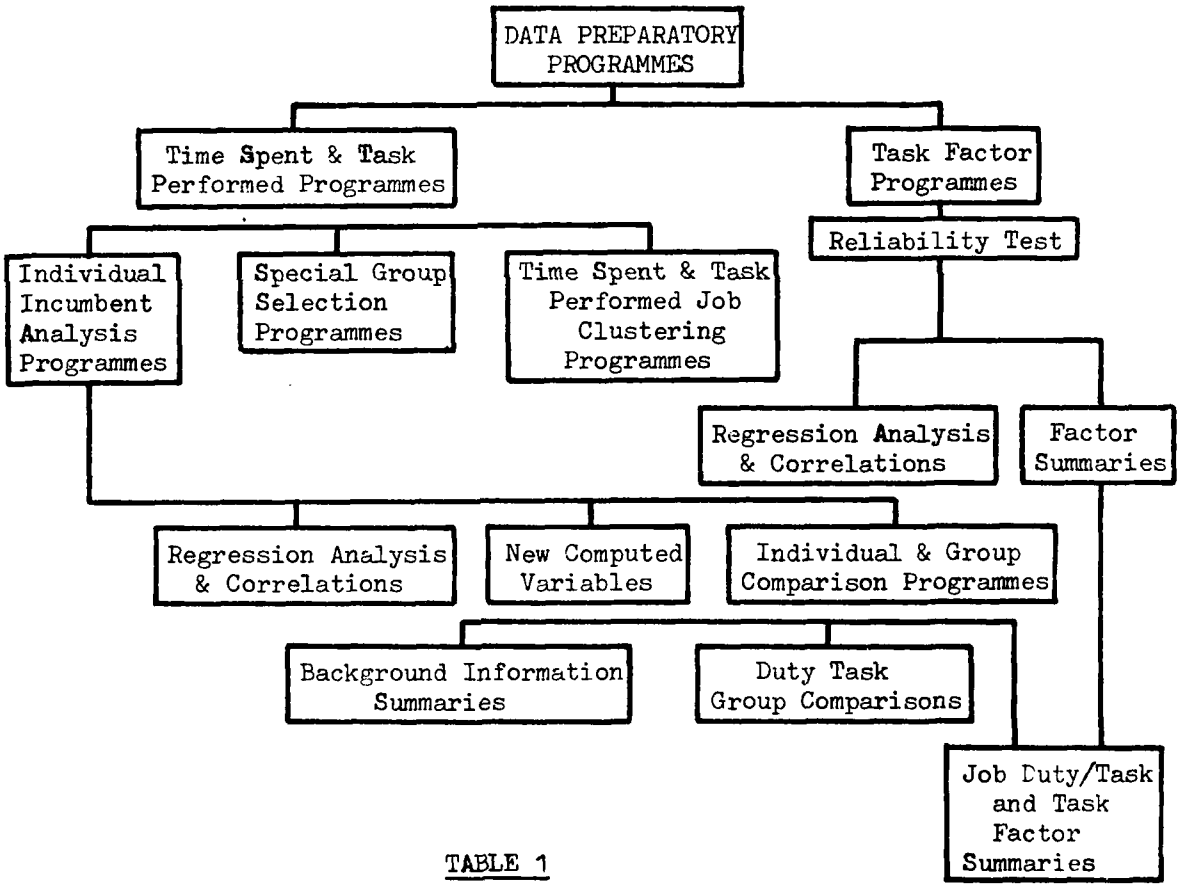


TABLE 1

3. The Data Prepatory Programmes take the raw optical scanned or key punched data and:

a. re-organize it into a form acceptable to all later programmes;

b. permit corrective editing directly by CODAP cell staff;

c. check for incumbent identity number and number of sheets of data, etc; and

d. prepare lists of duties, tasks and background variables ready for matching with computed data output in later programmes.

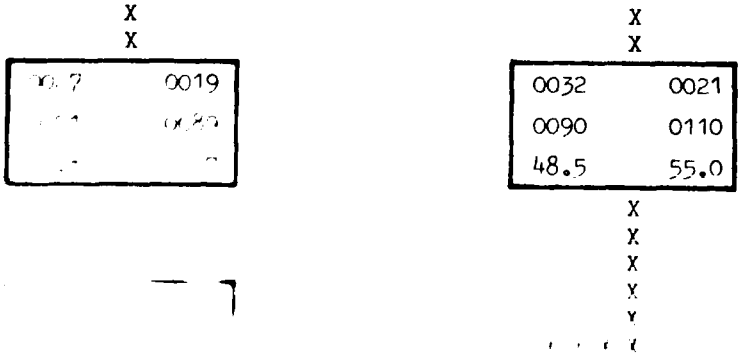
4. These programmes are of such a specialist and technical nature, that they will not be discussed further. But suffice to say, that the accuracy, validity and reliability of the data from later CODAP programmes is only as good as the input data from the raters. Poor inventory preparation - confusing, poorly designed, ambiguous questions and task statements - result in the rejection of large numbers of raters and/or subject data outputs. Some of the more important Time Spent programmes will now be discussed.

5. The Grouping Programmes take each incumbent's raw data responses, convert each task rating into a percent time spent for that incumbent and compute an overlap matrix. Each incumbent shows, through his ratings, that his job is different from other jobs, either by the tasks he does or does not rate, or by his emphasis as to the amount of time he spends on each task he performs.

6. Following the computation of the overlap matrix a clustering programme is applied which combines cases, according to their similarity index, by stages until all cases have been merged into a single group.

7. The Diagram Programme uses the data from the other clustering programmes to generate a tree-like diagram that graphically displays which groups were merged during the grouping process. Annex A shows the diagram for a sample of Army Engineering Aircraft Trades. Each group of jobs is represented by a rectangular block of data containing the most important information about that group. Table 2 describes a small portion of that printout.

SECTION OF THE ARMY ENGINEERING AIRCRAFT TRADES DIAGRAM



8. Using the last block of data in Annex A as an example, the numbers tell us:

0024 = Group Number. This group was formed by the merging of the two smaller groups 0027 and 0032. A description of the job performed by the average member of this group can be obtained from another CODAP programme which will be discussed later.

0040 = The number of members in this group, ie this group was made from clustering the two groups of 19 and 21 members.

0071-
0110 = The range of K-Path numbers exclusively allotted to the members of this group. These numbers uniquely identify each member so that other CODAP programmes can refer to these members.

44.4 = The average percentage of overlap <u>between</u> all possible pairings of the members of group 27 with the members of group 32. (399 averages = $N_1 \times N_2$.)

49.2 = The average percentage of overlap <u>within</u> all possible pairs of individuals within the final combined group 24. (780 averages = $\sum_{1}^{N_1 + N_2 - 1} (N_1 + N_2 - 1)$.)

9. The Group Job Description Programmes have been written to enable the computer to generate composite Job Descriptions made up of duties and tasks performed for any group of individuals. By nominating a group from the diagram - and thus a range of K-Path numbers - a Group Job Description at task level or at duty level, or both, can be produced for the average job performed by the members of that group.

10. As an example, Annex B, the Job Description for RAAF Armament Fitters will contain:

a. the percentage of members of that group that perform each task;

b. the average percentage of time spent by those members in the group who <u>actually</u> perform each task;

c. the average percentage of time spent on each task by <u>all</u> members of the group; and,

d. the cumulative sum of the average percentage of time spent by <u>all</u> members.

Other background variables may be used to characterize and thus nominate membership of a group.

10. The Group Difference Programme shows how one Job Group Description differs from another Job Group Description. It can suppress the printing of tasks where the differences are below some nominated minimum value, and also print the tasks in order of any of the columns of data. The distinct difference in tasks performed by Job Groups 27 and 32 in the Army Tradesmen Study is shown at Annex C. At the top of Annex C are the tasks that have large amounts of time spent on them and are performed by many members of Group 27. These tasks are typically those performed by Engines Tradesmen. But working from the bottom upwards, those tasks are supervisory in nature - and in fact we find Group 32 is made up of corporal engine fitter supervisors.

11. Job Group Difference Descriptions can also be obtained from any two groups of individuals that have been identified in terms of background variables. For example; one can obtain a description of the differences in tasks being performed by the group of people who find their work interesting and those who find their work dull; or the difference between Corporal RAAF Clerks and Corporal Army Clerks as long as the same task inventory has been used.

12. The Print Variables Programme generates a report of selected variables for selected groups of cases. When the report is for the whole sample of raters and is in K-Path order, it is especially useful in identifying similarity of background characteristics for groups formed by the clustering process. This capability aids the analyst in discerning which groups on the diagram printout are most susceptable to definition as meaningful job types and it is also useful in understanding and explaining the worker composition of a selected job group.

13. A section of the report, in K-Path order, is reproduced in Table 3, for groups 27 and 32 (that make up Group 24) of the Army Study.

RAEME AIRCRAFT TRADES - GENERAL BACKGROUND INFORMATION

GROUPS 27 AND 32

	K PATH NO	ECN	RANK	ARMY TIME	RANK TIME	UNIT TIME	TASKS DONE
	71	2	1:1	139	4	11	119
	72	2	1:1	28	25	11	83
	73	2	1:1	92	89	1	147
*27							
	87	2	2:1	55	18	48	94
	88	2	1:1	43	41	31	80
	89	2	1:1	40	37	27	57
	90	2	3:1	108	68	7	232
	91	2	3:1	90	1	1	113
	92	2	3:1	108	57	7	209
*32							
	108	2	3:1	146	50	24	229
	109	2	3:1	108	38	26	164
	110	2	2:1	118	36	24	281

ECN CODE: 1 = ARTIFICER AIRCRAFT
2 = FITTER AIRCRAFT ENGINES
3 = FITTER AIRFRAMES

RANK CODE: 1:1 = CRAFTSMAN SUBSTANTIVE
2:1 = LANCE CORPORAL SUBSTANTIVE
3:1 = CORPORAL SUBSTANTIVE

7 = WO1

TABLE 3

14. The first column is the K-Path number for each case. It is computer allotted so that the individuals in the group who have the most similar jobs have adjoining K-Path numbers. But similarily of the individual's jobs is reflected in the other columns of Personnel Background Information. These columns show similarity in:

Column 2. The employment code number or mustering, where 1 = Aircraft Artificer;
2 = Aircraft Engines Fitter and
3 = Airframe Fitter etc.

Column 3. Rank, where,
1:1 = Craftsman Substantive - Group 27
2:1 = Lance Corporal Substantive
3:1 = Corporal Substantive - Group 32

Columns 4, 5, 6 = Time in the Army, in that rank and at their present unit respectively - shows the more senior personnel in Group 32.

Last Column. Is the number of tasks performed by each individual of the possible 600 odd tasks in the inventory - again the more senior people in Group 32 stand out.

15. This report could have been arranged, for example, in ascending order of the incumbent's job interest, ranging from very dull to very interesting. That re-ordered display may highlight particular clusters of uninteresting jobs at a particular unit, or clusters of personnel that have not been cross trained - or are under employed in terms of the number or type of tasks they perform.

16. The programmes discussed so far have been orieted towards identifying and describing the types of jobs in an occupational category such as a mustering. But there is another set of programmes which manipulate information describing work tasks, rather than jobs or persons. These programmes assist in the analysis of factors - call task factors - which describe the nature and characteristics of each task, for example the difficulty for any new tradesman to learn to do the task staisfactorily.

17. The Programme REXALL, is designed to compute the mean and standard deviation of each task from a group of expert opinions as to the nature of those tasks. For example, a group of 27 specialist Non Commissioned Officers, using a 1 to 9 point scale, may rate each task as to the probable consequences of not performing each task satisfactorily, irrespective of who may normally do those tasks.

18. Annex D shows, for the RAAF's Electrical Fitter mustering, some of the tasks from that inventory arranged in descending order of adjusted means of the consequences factor. The strength with which this averaged expert opinion can be accepted may be judged from the inter-rater reliability coefficient, which can be loosely defined as the concensus of agreement between the raters. For this example it was .95 which is excellent. The Programme points out the rater who is non-co-operative or misreads the instructions and uses the scale in the reverse sense. The Programme can also adjust each rater's total opinion back to a common mean, ie it removes rater bias.

19. Finally the Task Factor Summary Programme can gather all the factors that describe the nature of each task - along with the earlier mentioned task performance factors - and tabulate them in such an order, that training course design personnel can make objective decision as to what training should be given, how much training should be given, and when.

20. Annex D shows, for the RAAF Electrical Fitter, a small section of the task inventory with a number of task performing factors (% AC performing % LAC performing) and task factors (consequences of inadequate performance, task learning difficulty, and the need for immediate performance). Training Design Managers and personnel responsible for maintenance of job skills would have to weigh the different factors against each other.

21. Thank you, copies of this paper are available in the display room, along with a display of computer printouts.

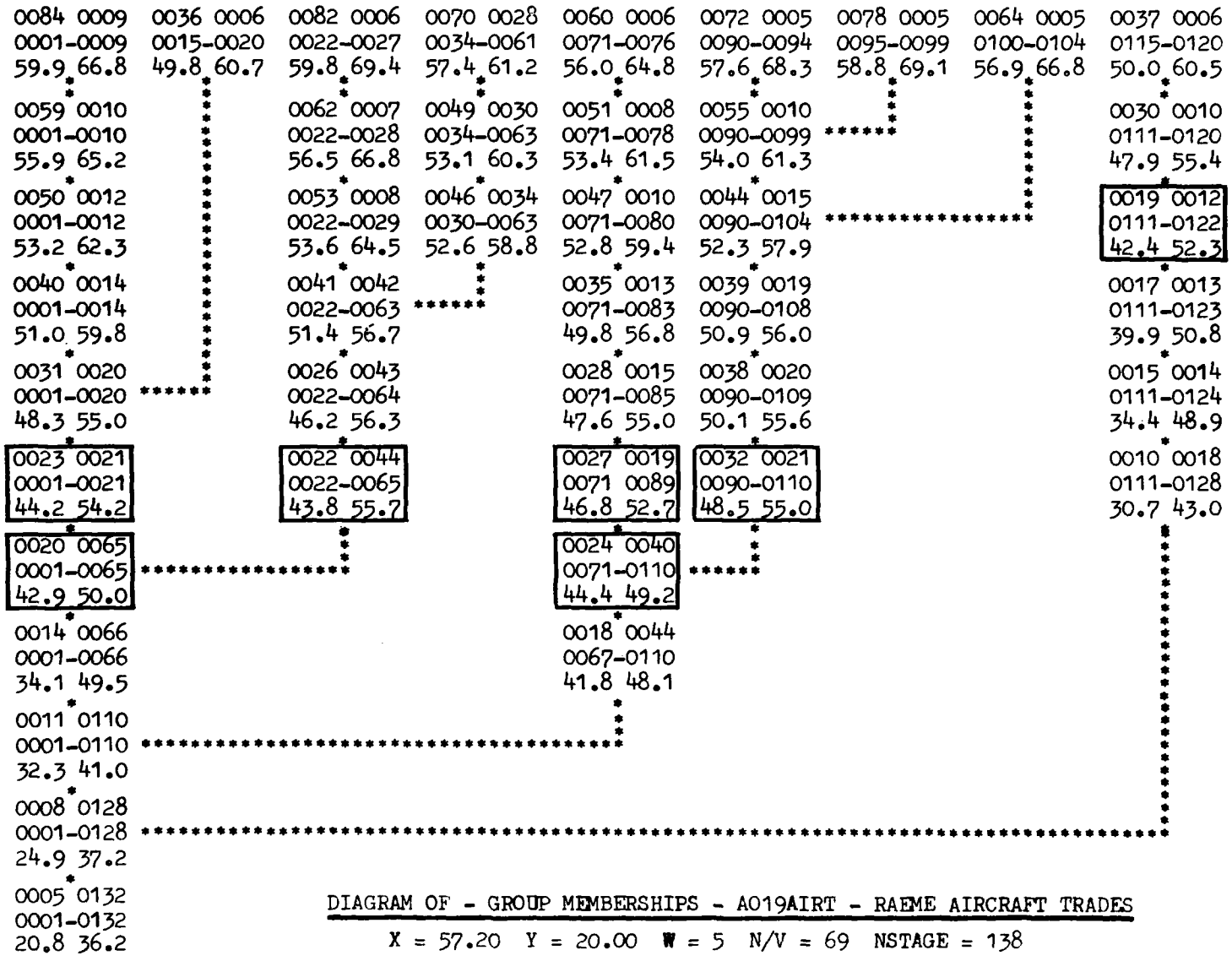


DIAGRAM OF - GROUP MEMBERSHIPS - A019AIRT - RAEME AIRCRAFT TRADES

X = 57.20 Y = 20.00 W = 5 N/V = 69 NSTAGE = 138

JOB GROUP DESCRIPTION RAAF Armament Fitters

TASK TITLE	Percent of Members Performing x	Average Percent Time Spent by Members Performing x	Average Percent Time Spent by All Members x	Cumulative Sum of Average Percent Time Spent by All Members x
INSPECT OR TEST SPECIAL - TO - TYPE MISSILE TEST EQUIPMENT	84.2	2.6	2.2	2.2
BAY SERVICE SPECIAL - TO - TYPE MISSILE TEST EQUIPMENT	68.4	2.8	1.9	4.1
INSPECT OR TEST SIDEWINDER MISSILE GUIDANCE UNITS	63.2	3.0	1.9	6.0
REPAIR SPECIAL - TO - TYPE MISSILE TEST EQUIPMENT	73.7	2.5	1.9	7.8
*	*	*	*	*
*	*	*	*	*
*	*	*	*	*
STACK AND HANDLE EXPLOSIVE ORDINANCE	63.2	2.4	1.5	33.1
*	*	*	*	*
*	*	*	*	*
INSPECT OR TEST SIDEWINDER MISSILES	36.8	3.1	1.2	56.8
GIVE ON-THE-JOB TRAINING	57.9	1.9	1.1	58.0
PARTICIPATE ON PARADES	89.5	1.2	1.1	59.1

DIFFERENCE BETWEEN GRP 27 and GRP 32

Average Percent Time by All Group Members Grp 27 MINUS Grp 32 ——— x
Group 32 Average Percent Time by All Group Members ——— x
Group 27 Average Percent Time by All Group Members ——— x

TASK TITLE			
REPLENISH OIL SYSTEM	1.71	.92	.79
REPLENISH FUEL SYSTEM	1.78	1.03	.75
PERFORM PRELIMINARY INSPECTION OF PROPELLOR	1.32	.61	.71
SERVICE ENGINE OIL SYSTEM	1.25	.86	.39
******** TASKS OMITTED WHERE THE DIFFERENCE IN AVERAGE PERCENT TIME IS LESS THAN .20 ********			
TEST CONFIGURATION CHANGE EQUIPMENT	.05	.34	-.29
PERFORM SUPERVISORY INSPECTIONS ON TRANSMISSION MAINTENANCE	.10	.57	-.47
PERFORM SUPERVISORY INSPECTIONS ON ENGINE SERVICE	.00	.75	-.75

INTER-RATER RELIABILITY FOR THE TASK FACTOR - CONSEQUENCES OF INADEQUATE PERFORMANCE (RAAF ELECTRICAL FITTER)

(Mean adjusted to 5.0, Standard Deviation adjusted to 1.0)

TASK NO.	TASK TITLE	NO. of RATERS	MEAN CONSEQ	SD
37	Service a/c fire extinguisher systems	27	6.3	.72
45	Service a/c electrically operated detonation systems	27	6.2	1.1
122	Troubleshoot a/c flying control systems	27	6.0	.76
214	Benchcheck a/c fire/overheat detectors	27	6.0	.73
117	Troubleshoot a/c fuel distribution control or indicating systems	27	5.5	.62
284	Repair MT and GSE lead - acid batteries	27	4.7	.71
250	Service mobile lighting systems	27	4.7	.85
296	Repair ground refrigeration systems	27	4.5	.53
317	Draft correspondence such as minutes, memoranda or letters	27	4.2	.80
356	Perform base rostered duties other than duty crew	27	3.4	.78
361	Maintain lawns and gardens	27	2.2	1.2

FACTOR SUMMARY
(RAAF ELECTRICAL FITTER)

TASK NO.	TASK TITLE	%M AC	%M LAC	%M CPL	RECOMMENDED AC TRAINING	CON SEQ	TSK DIF	IMM PER
37	Service a/c fire extinguisher systems.	21	26	24		6.3	5.4	5.8
45	Service a/c electrically operated detonation systems	0	16	23		6.2	5.1	5.5
122	Troubleshoot a/c flying control system	0	15	14		6.0	6.3	5.9
214	Benchcheck a/c fire/overheat detectors	12	13	13		6.0	5.0	5.6
117	Troubleshoot a/c fuel distribution control or indicating systems	6	29	37		5.5	5.7	5.6
284	Repair MT and GSE lead-acid batteries	18	11	7		4.7	4.6	4.3
250	Service mobile lighting systems	9	13	17		4.7	4.5	4.1
296	Repair ground refrigeration systems	15	5	5		4.5	5.8	4.6
317	Draft correspondence such as minutes, memoranda or letters	0	0	15		4.2	5.6	4.2
356	Perform base rostered duties other than duty crew	59	46	61		3.4	3.0	4.7
361	Maintain lawns and gardens	15	14	15		2.2	2.8	3.1
					R_{KK}	.95	.96	.91

PREPARATION OF INVENTORIES

Warrant Officer Class One, W.J. Noble (MERIT)

INTRODUCTION

1. The aim of this paper is to outline the stages and procedures applied by the Job Analyst - Military Employments Research and Information Team (MERIT) in the preparation of task inventories. A Task Inventory being a comprehensive check list of all the activities an incumbent of a particular job may be expected to perform.

TASK INVENTORY STAGES

2. There are four (4) stages to be considered in the preparation of task inventories and they are as follows:

a. planning conference,

b. research of data,

c. task inventory construction conference, and

d. task inventory compilation.

PLANNING CONFERENCE

3. The survey planning conference is arranged to formulate the objectives for the survey and to establish the initial planning guide lines. At this meeting the following points are established:

a. the specific aims of the survey (survey objectives),

b. information needs which the survey may satisfy,

c. sponsoring directorate responsibilities, which include:

(1) provision of personnel for inventory compilation and review panels,

(2) composition, location and proposed dates for inventory construction.

4. At the completion of this meeting the Job Analyst is able to establish a timetable for all stages of the survey to facilitate planning and actions to meet the target date set for the survey.

RESEARCH OF DATA

5. When the requirements for a survey have been identified the Job Analyst as part of his planning has as research sources:

a. previous MERIT surveys,

b. employment specifications,

c. similar surveys conducted by other services, and

d. trade structure printout.

TASK INVENTORY CONSTRUCTION

6. The task inventory is used to identify the employment areas and tasks applicable to Army trade. With the use of rating scales the task inventory can identify the time spent, involvement, importance and immediacy factors governing the tradesman.

7. The Job Analyst with the expert assistance of the panel members constructs the task inventory in the following stages:

a. Establishes the areas of responsibility (trade and misc) of all members at each rank level within the trade.

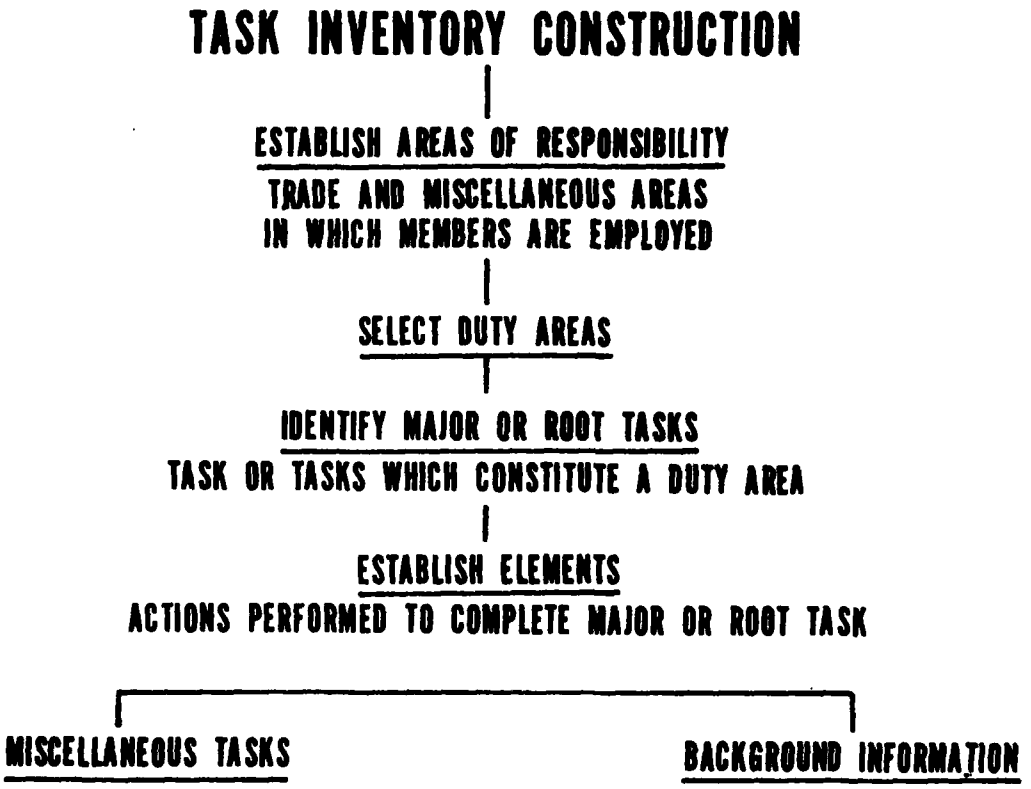
b. From these select relevant duty areas and by discussion construct:

(1) The root tasks which are the task or tasks applicable to each duty area.

(2) By discussion and questioning of panel members ascertain the elements which are the actions performed to complete a root task.

(3) Establish the miscellaneous trade tasks (those that do not fit into a particular duty area). These are included in a separate area at the end of the inventory.

(4) The requirement for background information which is a description of the soldier in regard rank, length of service, time in employment and other such detail.



MAJOR POINTS FOR CONSIDERATION IN CONSTRUCTION

8. During the construction stage the Job Analyst must consider at all times the following points in relation to the trade being surveyed:

a. how are members employed in the trade,

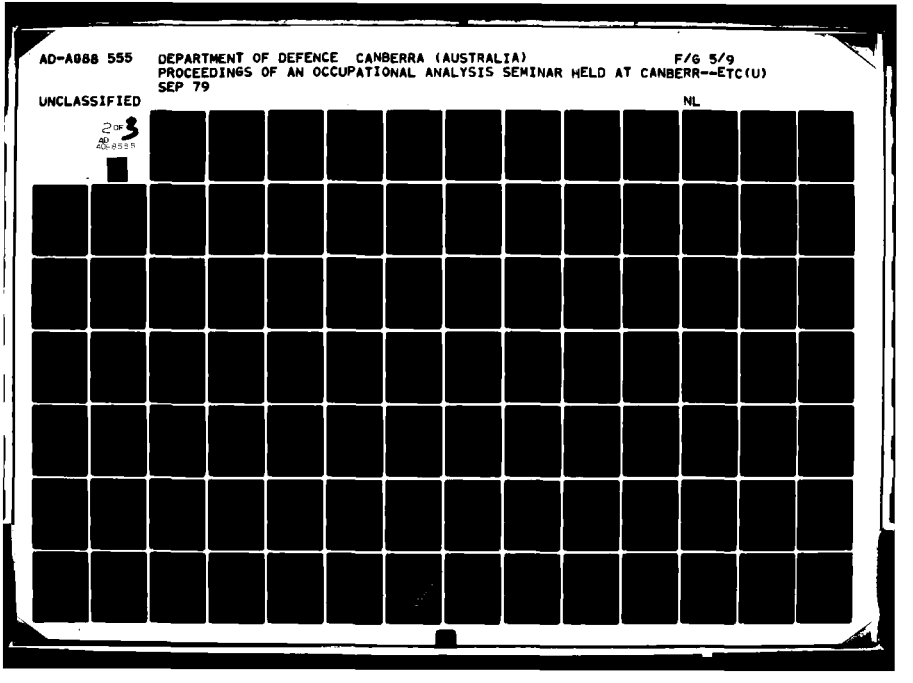
b. day to day job functions,

c. role of various ranks,

d. level of root task,

e. level of elements. Are they skill or knowledge, and

f. task statement should begin with present tense action word.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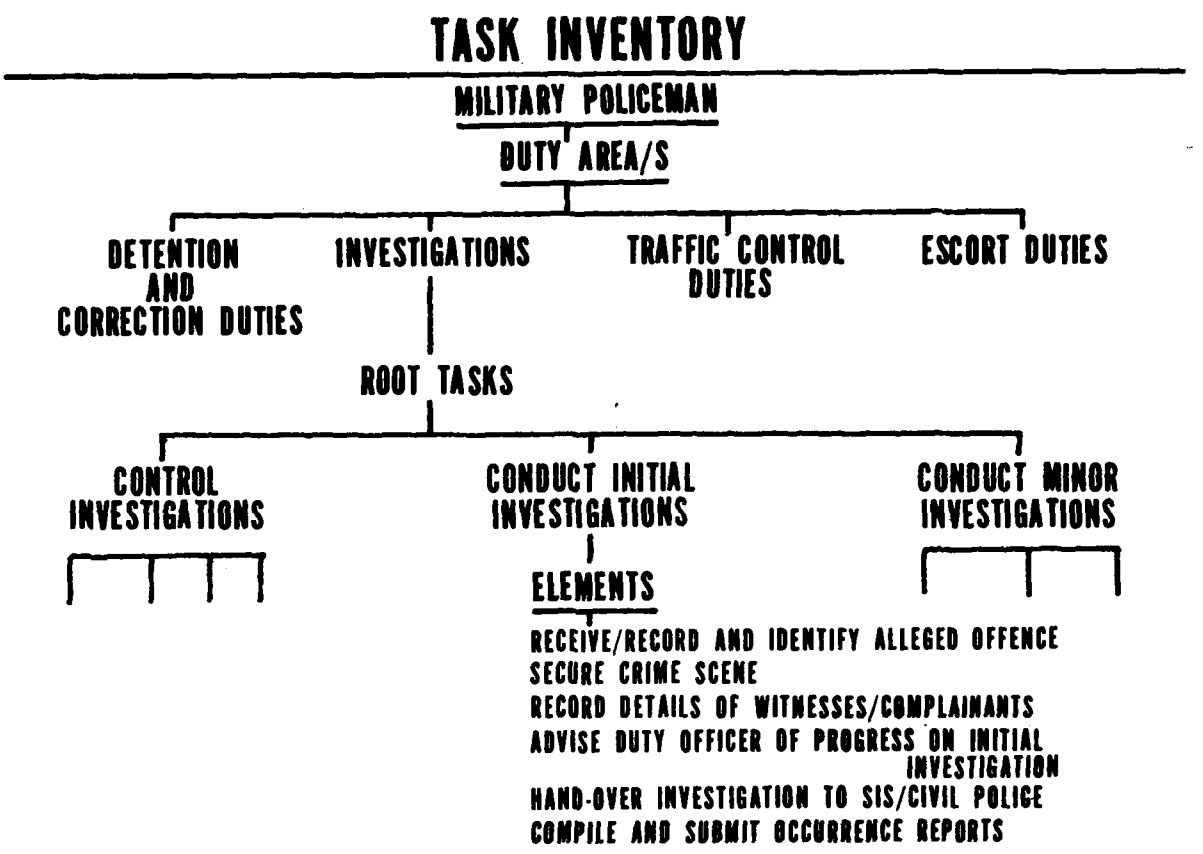


COMPILATION

9. On completion of the task inventory construction the Job Analyst is responsible for the compilation, and prior to commencement ascertains the survey method to be used, and if layout to be used is:

a. punch card method, or

b. optical scanning sheets (OPSCAN).

PART A - TASK INVENTORY - INCUMBENT

a. Using the scales shown in the response guide, rate only those tasks ticked in the 'P' column.

b. Use Occupational Analysis Response Sheet 01 for consecutive tasks 1-100.

	TASK		P
	DUTY A - BAR DUTIES		
	Perform Bar Hygiene		
1.	Wash glasses by hand	1.	
2.	Clean bar equipment	2.	
3.	Clean bar area (shelves, counter, floor etc)	3.	
	Perform Bar Operation/Maintenance		
4.	Set up beer dispensing equipment	3.	
5.	Maintain beer dispensing equipment	5.	
6.	Operate beer dispensing equipment	6	
7.	Perform opening/closing procedure for bar operation	7.	

10. The structured task inventory is then drafted ensuring that:

a. Task statements are clear and understood.

b. Task statements restricted to sixty (60) characters in length for ease of processing.

c. Task statements rateable in terms of 'time spent' and other factors in current use.

d. Inventory restricted to twenty six (26) duty areas and 1700 tasks.

CONCLUSION

11. On completion of the compilation stage in conjunction with the previous steps detailed the inventory is completed in draft form and would at this stage be reviewed by another panel or by mail to ensure all trade areas have been included prior to final drafting.

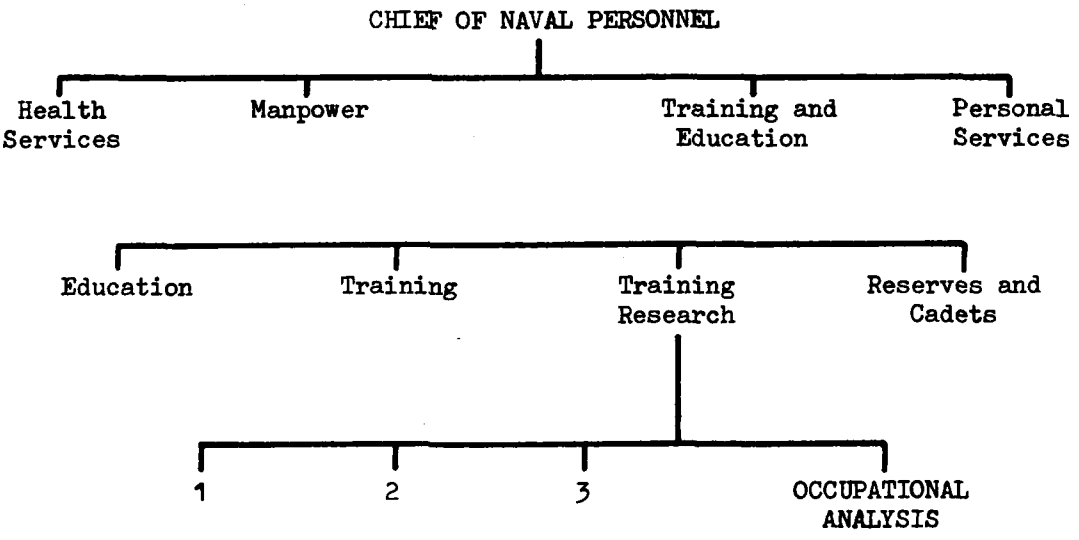
THE APPLICATION OF CODAP/OCCUPATIONAL ANALYSIS IN THE RAN

Lieutenant Commander R. Hawketts, RAN

1. The Navy's Occupational Analysis cell is small in comparison with units fulfilling the same role for other Services, both in Australia and overseas. This is not only because the Navy itself is small. Most probably it is because the Navy has not yet gained a full appreciation of the potential use and impact of a Comprehensive Computerised Personnel Management Data Base driven by a program suite with the power of CODAP.

2. The Navy's OA unit is in the Directorate of Naval Training Research which is the junior Directorate of the Training and Education Branch of the Personnel Division (Table 1). Its total strength is two officers and two senior sailors with one WRAN Writer.

TABLE 1



3. With a staff of this size, the method of work is to proceed with just one study at a time until the Data Base is firmly established on the computer. Subsequently the OA unit will continue to provide an information service from it for as long as the data is considered sufficiently recent and pertinent. Our method of work then is on a one study, one team basis and has more in common with the approach of the United States Marine Corps than with the other United States Services.

4. Some years ago at a symposium on the "State of the Art in Occupational Analysis", Dr Christal gave a set of recommendations to organizations planning large scale Job Analysis using Task Inventories. One of these was to obtain and use the CODAP package and to modify it if necessary to meet individual needs - clearly a recognition that the requirements of an Occupational Analysis and its method of execution depend on the size and structure of the personnel system which it serves. With the range of Military organizations now using CODAP for diverse reasons, it would indeed be surprising if all user units had the same modus operandi.

5. The United States Navy, for instance, directs its Occupational Analysis work towards Manpower Planning, Personnel Structures, Manpower Modelling and Training. Obviously it is a widely used activity, but bearing in mind the considerable research investment which the USN have made in this field for many years, together with the use of CODAP for the past eight years, this is hardly surprising. It would be a mistake however, if we in the RAN were to lavishly follow the methods used so successfully by the USN.

6. Notwithstanding the tremendous difference in numerical strengths between the USN and the RAN, the range of ship types operated and therefore the spectrum of work undertaken, bears comparison. To illustrate the possible differences in OA requirements, we can compare the personnel frameworks of the RAN and the USN to meet this range of tasks (Table 2).

TABLE 2

NAVAL PERSONNEL SYSTEMS

	R.A.N.	U.S.N.	
BRANCHES	12	24	OCCUPATIONAL FIELDS
CATEGORIES	42	74	RATES
		1200	NAVY ENLISTED CLASSIFICATIONS

The RAN's "Branch" is broadly similar to the USN's "Occupational Field", as is "Category" with the USN "Ratings". The difference must be in range of tasks carried out by the two sailors. However, the USN breakdown doesn't finish there - it also lists 1200 Navy enlisted classifications (NECs) which are important qualifications for many postings. Most sailors in the USN have either one or two NECs to supplement this rating and perhaps to produce a more definitive pattern of postings. Such a detailed structure can be supported by a half million strong Service, but it would prove too restrictive to the smaller Navy.

7. Table 3 shows the range of five NECs associated with the Yeoman Rate.

TABLE 3

OCCUPATIONAL FIELD 15 = ADMINISTRATION

RATES	Personnelman	Yeoman	Legalman
	Religious Programme Specialist	Postal Clerk	Navy Counsellor

NEC's	Flag Officers Writer	Personnel Records Admin	
Legal Clerk	Court Reporter		Staff Writer

We can see that the RAN Writer Category would cover much of the work of all these rates - although Religious Program Specialist billets would be difficult for him.

8. Much of the OA work in the USN during the early 70s was in support of investigations into the rationalisation of career ladders and NECs, activities which used task inventories covering the range of work of several related NECs.

9. With a Service the size of the RAN, comprehensive personnel research, as carried out by the US Military, is not economically viable. For this reason, Job Analysis which started in the RAN in 1972, was the result of a perceived need within the new training system rather than a thoroughly researched support activity

and consequently progressed on very much a trial and error basis. Thus when the CODAP tool was obtained, its power and width of application were not fully appreciated. Consequently early studies had limited aims since they were initiated by individual Directorates.

10. To date almost fifty percent of RAN personnel have each completed one of the seven questionnaires so far distributed. With the exception of a small survey undertaken in support of a pay level investigation, all have been directed primarily at one or more stages of training design. (Table 4)

TABLE 4

R.A.N. OCCUPATIONAL ANALYSIS SURVEYS

CATEGORY/BRANCH	REASON	No. Of MEMBERS
Communications	CODAP Trial	700
Safety Equipment	Training	60
Marine (Hull & Propulsion)	Training	2000
Weapons Electrical	Training	1500
Air Engineering	Training	600
Submarine Engineering	Training	200
Seamen	Training	400
Stewards	Pay Level Support	400
		6000

11. Since these surveys have been concerned with Job Analysis, the questionnaires used have been lengthy in terms of their task inventories, yet the level of task detail identified is generally considered too coarse for training design purposes. These inventories consist of up to 1,000 items, and it is felt that longer inventories would alienate both respondents and managers to the extent that the willing co-operation which the OA unit has met to date could be lost. Perhaps studies aimed specifically at training should utilise secondary questionnaires restricted to incumbents of fairly narrow job definition such as "Leading Writer Pay Office" rather than "Writer Category, All". This has the disadvantage that since we do not design training modules for such discrete employments, training design would have to be the result of a number of related surveys.

12. It is anticipated that the Survey of Officers and Warrant Officers currently underway will have considerably more impact in the Naval Personnel Division since many Directorates were actively involved in structuring the several sections of the Data Gathering Document. Time will tell.

CURRENT USE OF OA IN THE MILITARY

Major A. Davidson

1. As mentioned already, Navy, Army and Air Force activities and approaches to occupational analysis (especially the compilation of Task Inventories) differ to a degree because of the way each cell grew up, and the personnel structure within each cell.

2. MERIT is fragmented in its approach to the total Survey. Unlike the Navy, and to a lesser degree, unlike the Air Force, the survey process, while controlled overall by myself, is split into discrete areas of responsibility. We can divide these into a few basic groups.

TABLE 1.

AREAS OF RESPONSIBILITY

SO2	• PRIORITIES • CONTACTS/LIAISON	• OVERALL CONTROL
SO3 (TECH)	• BOOKLET LAYOUT • PROCESSING METHOD	• TECH LIAISON • FINAL REPORT
SO3 (ADMIN)	• ALL CORRESPONDENCE • LIAISON/CONTROL OF TYPING/PRINTING	
JA (M)	• T.I. COMPILATION • REVIEW	• DESPATCH/RECEIPT • EDIT/RECEIPT

3. Apart from this fragmentary approach, the main point to be emphasised is that compilation and review of the Task Inventory is carried out solely by the Warrant Officer to whom that particular survey has been allocated. With the assistance of the sponsoring directorate he organises both panels and the venue and then guides the panel of job experts in the Inventory construction.

TABLE 2.

MERIT - THE SURVEY PROCESS

	SO2	SO3 (TECH)	SO3 (ADMIN)	JA (M)
PLANNING	X	X		X
TICC & COMPILATION				X
PRINTING			X	
SURVEY				X
RECEIVE/EDIT			X	X
DATA PREP/ PROCESSING		X		
REPORT	X	X		

4. The process shown in Table 2 is comparable to the procedures employed throughout all services. The pilot study is an area now being used less and less by Army, since the booklet layout and administration procedures have, over the past three or so years, proved themselves adequate in allowing us to achieve our objectives.

5. Turning to the actual survey, a point worth making concerns the factors used by Army respondents in rating the tasks performed.

TABLE 3

INVOLVEMENT

Involvement is a measure of your participation in the tasks you perform. If you only assist in a task you will rate your involvement as being low, while tasks that you supervise will be rated high. Select the value which best describes your participation in the task.

1 - I ASSIST, UNDER SUPERVISION, IN THIS TASK

2 - I MOSTLY ASSIST, BUT SOMETIMES PERFORM THIS TASK

3 - I USUALLY PERFORM, BUT SOMETIMES ASSIST IN THIS TASK

4 - I USUALLY PERFORM THIS TASK

5 - I USUALLY PERFORM, BUT SOMETIMES SUPERVISE THIS TASK

6 - I MOSTLY SUPERVISE, BUT SOMETIMES PERFORM THIS TASK

7 - I SUPERVISE THIS TASK

TIME SPENT

This response (rating) is a measure of the amount of time you spend on a task. The rating you give a task is estimated by comparing the time you spend on that task with the time on all other tasks. Tasks which occupy a lot of your time are rated high, while those taking little time are rated low. Try to use the full range of the scale to show the way your work time is distributed.

1 - WELL BELOW AVERAGE

2 - BELOW AVERAGE

3 - SLIGHTLY BELOW AVERAGE

4 - AVERAGE

5 - SLIGHTLY ABOVE AVERAGE

6 - ABOVE AVERAGE

7 - WELL ABOVE AVERAGE

] AMOUNT OF TIME SPENT

6. The person actually performing the job is asked to rate each task performed on these two factors - Time Spent and Involvement. The Involvement question has the main function of assisting trainers to determine training requirements and levels of that training which proves necessary.

7. The same Task Inventory is then given to selected supervisors who are asked to rate ALL tasks on one or the other of these factors.

TABLE 4

RESPONSE GUIDE - SUPERVISORS

IMPORTANCE RESPONSE

This response (rating) is a measure of how important the task is in relation to its effect on the units mission in peace or war. If neglect or poor performance of a task would have little or no effect on the ability of the unit to achieve its mission it is rated LOW. A task, which if neglected or performed poorly, would result in rapid deterioration of the units ability to achieve its mission, is rated HIGH.

1 - UNIMPORTANT

2 - LOW IMPORTANCE

3 - BELOW AVERAGE IMPORTANCE

4 - IMPORTANT (AVERAGE IMPORTANCE)

5 - ABOVE AVERAGE IMPORTANCE

6 - HIGH IMPORTANCE

7 - CRITICAL

IMMEDIACY RESPONSE

Immediacy is an assessment of how soon after taking up an appointment (marching into the unit after training) an incumbent is expected to satisfactorily carry out the task.

1 - NOT WITHIN TWELVE (12) MONTHS

2 - WITHIN TWELVE (12) MONTHS

3 - WITHIN SIX (6) MONTHS

4 - WITHIN THREE (3) MONTHS

5 - WITHIN ONE (1) MONTH

6 - WITHIN ONE (1) WEEK

7 - IMMEDIATELY

8. Again the training implication for these factors is obvious, more so in the types of training which should be decided upon.

- Formal classroom training on a course
- On the job training while being actually employed in his trade, or
- No training.

9. In the Army, an occupational analysis survey may be initiated basically by one of three methods. Depending on which method is employed, the objectives vary to some degree.

a. Sponsoring Directorate Approaches MERIT. This approach can result in a series of objectives like:

(1) Should such and such trade be split into two trades.

(2) Should several trades be amalgamated.

(3) What equipments are used where and for what percentage of time.

(4) Correlation of job satisfaction with area/ unit of posting.

b. The Directorate of Personnel Plans (DPP) Approach MERIT. Being concerned with Soldier Policy, DPP is, among many other things, interested in Job Specifications being kept up to date. That is, that the soldier is in fact doing what Army Office thinks he is doing. The training implications in this area are obvious. DPP is responsible for the Manual of Personnel Administration, where also

outlined is the MERIT Charter which mentions that most trades should be surveyed every 3 to 5 years.

c. MERIT Itself Initiates. In line with the Manual of Personnel Administration MERIT keeps a log of all trades and the dates they were last surveyed. In discussions with the Sponsoring directorate, MERIT keeps a track of introduction of new equipment, changes in unit function or mission, variations in training methods or policy and trade structures.

10. MERIT averages some 15 surveys a year. As of last August in various stages of the survey process we had 21 surveys. Some of these were carryovers from the last months of 1978. The delays are mainly attributed to a somewhat deficient mark sensing machine - the OPSCAN. To add to the difficulty the earliest surveys are by far the largest we have done. These are mainly in the clerks and storemen areas.

11. Currently MERIT is also involved in carrying out a survey, not really OA oriented, to validate the recommendations of the Regular Officer Development Committee (RODC) to formalize Officer Employment Categories (OEC). A broad ranging and technically sophisticated job analysis will be necessary in the long run for the complete evaluation and categorization of all officer appointments.

12. In the short term, the most important need is to provide adequate information on jobs to enable the personnel managers in the Military Secretary Branch to manipulate data on individuals and jobs using CLIO (their computer facility). This will assist in panelling officers for appointments.

13. There are other short term needs. It is desired to obtain information to confirm or adjust the Staff Officer Employment Categories proposed by the RODC. This means that the scope of the job analysis should be limited initially in the non-Corps area, as this is the area identified by the RODC as most in need of attention. There is also an urgent need to obtain better information on training and education needs.

REPORT FROM THE RAAF OCCUPATIONAL ANALYSIS CELL

Squadron Leader K.J. Dowrick, BSc, BEd, MEd (Admin)

INTRODUCTION

1. The overall aim of this paper is to provide a status report from the RAAF occupational analysis (OA) cell. The cell is known as GT3A OA and Training Evaluation Section; it is located in the Ground Training Division, Headquarters Support Command (HQSC), Victoria Barracks, Melbourne. GT3A Section is responsible for: the development of OA and training evaluation procedures applicable to the RAAF; the conduct of RAAF OA and other surveys; and the training of RAAF managers in the use of OA data. The Section is established for three officers (GT3A Squadron Leader of the Special Duties Education Category (ED), GT3A1 Flight Lieutenant (FLTLT) ED and GT3A2 (FLTLT ED)) and two supporting clerical staff. Over the past six years the section has been fortunate in having the GT3A1 post manned by a USAF exchange officer. Each of these exchange officers have made many valuable contributions to the RAAF OA programme. Currently, the post is manned by Captain C.D. Gorman (USAF).

2. HQSC (Ground Training Division) is tasked by Department of Defence Air Force (DEFAIR) to undertake OA surveys on selected musterings. The tasking for 1978/79 is shown at Table 1. Ideally, these surveys should be updated every three to four years so reasonably current OA data is available on each of the 108 different musterings. However, this would require GT3A to survey at least 27 musterings per year. Over the past three years, the GT3A Section has managed to survey only seven musterings per year. Thus, with such a shortfall from the desired output, the sections tasking has been focused on surveying those musterings where it is felt the need is greatest.

TABLE 1

OCCUPATIONAL ANALYSIS AND TRAINING EVALUATION SECTION (GT3A)

PROJECTS 1978/79

Project	
CLK, CLKA, CLKG, CLKM	OCCUPATIONAL SURVEY
PHOTO	OCCUPATIONAL SURVEY
MEDORD	OCCUPATIONAL SURVEY
INSTFITT	OCCUPATIONAL SURVEY
AFFITT	OCCUPATIONAL SURVEY
AMWKR	OCCUPATIONAL SURVEY
SURFIN	OCCUPATIONAL SURVEY
SEW	OCCUPATIONAL SURVEY
RADTECHA, RADTECHG, TELSTECH	OCCUPATIONAL SURVEY
BOILATT	OCCUPATIONAL SURVEY
SP, SGUARD	OCCUPATIONAL SURVEY

Project	
COOK	OCCUPATIONAL SURVEY
EDASST	OCCUPATIONAL SURVEY
DMANENG	OCCUPATIONAL SURVEY
LINESMAN	OCCUPATIONAL SURVEY
PTI	OCCUPATIONAL SURVEY
HYGIENE INSP	OCCUPATIONAL SURVEY
ELECTRONIC PRINCIPLES (RADIO)	SPECIAL PROJECT
ENGINE FITTER COURSE VALIDATION	SPECIAL PROJECT
EQUIPMENT OFFICERS INITIAL COURSE STUDY	SPECIAL PROJECT
VALIDATION OF THE MATHEMATICS CONTENT OF AIRMOVEMENT COURSE	SPECIAL PROJECT

AIM

3. As mentioned above, this brief provides an outline of the RAAF OA programme. More specifically the aim of this brief is to:

a. Discuss in general terms the kinds of OA programmes being conducted.

b. Discuss the uses to which OA data has been put.

c. Discuss the future of the RAAF OA programme.

KINDS OF PROGRAMMES BEING CONDUCTED

Description of RAAF OA

4. In order to give you an idea of the type of data we collect, I will briefly describe the response booklets used by the RAAF. Each booklet contains two sections. The first section consists of background questions to be answered by the respondent about his job and himself ... time on the job, tools utilized, equipment worked on, interest in the job and so on. Any other questions of interest can be included in the background information section of an OA booklet.

5. The second section of the booklet is simply a list of all the significant tasks performed by members of the mustering being surveyed. That is, it includes tasks being performed by all ranks in the mustering. Provided this task list is properly constructed, then every member of the mustering should be able to define his job adequately in terms of a subset of tasks in the mustering. Table 2 lists the procedure used by the RAAF OA cell for the development of the task inventory and background information sections.

TABLE 2

PROCEDURE FOR THE DEVELOPMENT OF A TASK INVENTORY

1. Preliminary preparation by GT3A.

2. Review by specialist NCOs.

3. Review by command staff officers.

4. Field review by specialist NCOs on units.

5. Construction of final inventory.

6. Normally, the RAAF aims to survey between 80 and 100 percent of the members in the mustering. Presidents of Unit Trade Test Boards (UTTB) are responsible for the administration of the survey at unit level and at units where there is no UTTB, commanding officers are responsible. To be eligible to complete the survey, a respondent must have been in his present mustering for at least two months and in his present posting and present job for at least one month.

7. Each member selected to complete the survey checks the tasks he performed and how his worktime is distributed across the tasks in his job. At a later date about 45 supervisors rate selected tasks on one of the following factors:

task learning difficulty, consequence of inadequate performance, and need for immediate performance.

8. The responses are then processed (either by keypunching on to cards or optical scanning onto tape) to produce an input suitable for the computer to enable the data bank to be established. The basic outputs from the data banks are job specifications; these list all the tasks performed by the sample or part of it and are arranged in order of time spent on or percentage performing these tasks. From selection of such specifications is derived the whole family of comparisons, matrices and diagrams.

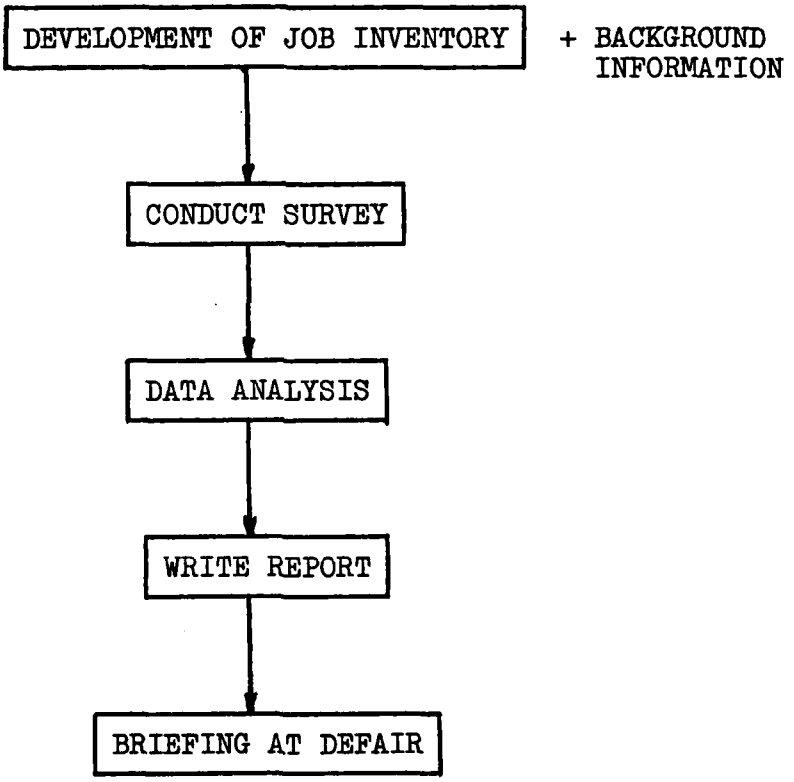
9. At this point I feel it is appropriate to state an important point which is often overlooked. OA produces an accurate picture of the present state, this is an important point to recognize since OA does not forecast what the future employment will be, nor does it forecast what it could be. This must be left to policy makers, administrators, or trainers, though they should be guided by the existing situation as shown by the OA data.

10. The initial request from our OA cell to Computer Services Division (CSD) Canberra lists the CODAP outputs such as DIAGRAM, PRINTVAR, and some initial job descriptions for ranks. Examination and interpretation of these outputs generates further requests for addition CODAP outputs eg, job description or AUTOJT to help identify different groups on the DIAGRAM.

11. After the analysis of the data is completed, the occupational analyst involved in surveying the mustering writes a report summarizing aspects he believes are relevant. After the report is printed, a briefing is given at DEFAIR to representatives of the Directorate of Training, the specialist officer for the mustering and other interested members. Table 3 summarizes the various phases of an OA survey on a mustering.

TABLE 3

VARIOUS PHASES OF OCCUPATIONAL ANALYSIS SURVEY



Special Projects

12. As well as tasking in OA projects the OA and Training Evaluation Section also is tasked with a number of special projects which require the development of a questionnaire to suit the requirements of each project. The following special projects were undertaken in the 1978/79 period: Electronic Principles Inventory (EPI), Engine Fitter Course Validation, Survey of the Contents of the Equipment Officers' Initial Course (EOIC), Validation of the Mathematical Contents of the Air-movements Course.

13. The EPI survey involved validating the electronics content of the trade training courses for the mechanical and electrical trades. So informative was the data from this project, that DEFAIR requested a similar survey be conducted to validate the electronics content of the radio trades basic trade training course. The EPI survey was outlined by Captain Gorman in his lecture yesterday.

14. The EOIC study's aim was to collect data to validate the course and assist in any course redesign that may be considered necessary. The following information was received concerning 152 syllabus items: time spent; use in job; frequency of use; level of training, and training received. The survey provided valuable information for improving the course.

15. The remaining two special projects did not employ CODAP outputs and therefore will not be outlined in this brief. However, CODAP was used to provide outputs in the Officers Education and Training (OET) Project. This project was outlined by Wing Commander Huet in his lecture yesterday.

Use of OA Data

16. GT3A Section has recently developed a procedure for using OA in curriculum design. This procedure has been successfully used and it appears that it is in this area that RAAF OA could make one of the most valuable contributions to training. In addition, OA data has been used for some time to assist in the production of trade standards and trade tests. The procedures used in curriculum design and trade tests will be outlined in the session titled "Production and Validation of Trade Specifications and Graduation Requirements".

17. As well as the special projects designed to validate part or all of a training course, validation of some courses has been achieved using OA data. OA data can provide information which can identify tasks being trained which incumbents are unlikely to encounter on the job. Although schools can usually determine where additional training should be given through feedback from user units, it is far more difficult for them to identify training that can be safely eliminated or reduced. Thus, OA can make additional contributions to validation of training.

18. Finally, the potential for use of OA data in other areas is considerable. In the future survey data may be used to assist in the restructering of musterings or determining their responsibilities; in posting actions which may match specific jobs with specific individuals known (through the OA cell) to have the necessary prior experience for the job in question; and in answering other personnel/administration questions.

Recent Changes in RAAF OA

19. One of the major changes made in the collection of OA data was the removal of the involvement scale from the task inventory, leaving only the time spent scale. This decision was mainly based on practically no user requirement for involvement data and the ease of collecting this information on specific tasks (if required). The decision to discontinue using the involvement scale resulted in a reduction of almost 50 percent in the number of OPSCAN sheets required for each survey.

20. Another change of interest is the introduction of the matrix format for some musterings that encompass a particularly large number of tasks. Attempts to survey such broad musterings may result in a linear list of tasks which is probably more than a respondent can handle (without a probable reduction in validity and reliability). The question of reliability and validity will be researched, in the near future by comparing the data from the matrix format with that from the well researched linear format.

The Future of the RAAF OA Programme

21. We in the RAAF OA cell are convinced that the CODAP has much to offer the RAAF but, unfortunately, only limited use seems to be being made of the data since CODAP became available to the RAAF in late 1974. This can partly attributed to the fact that no individual or group was specifically tasked with reviewing training using the available OA data as an input. Thus, it is up to the individual specialist officer to conduct such a review if he can somehow make the time available from his primary duties to do so. In most cases initial interest is shown by the specialist officer in the results of the survey, but usually the OA data ends up on a shelf gathering dust. Thus, unless a team is established for the specific purpose of reviewing training, there is little likelyhood of the OA data being used to any great extent.

22. The RAAF OA cell also sees the lack of use of data as being partly attributed to its failure to convince the potential user of the advantage of using the OA data. Thus, to overcome our failure to sell the programme, we have undertaken a public relations programme. This includes personally contacting potential users for their inputs to a survey instrument and personally delivering (complete with briefing and discussion session) every OA report to those responsible for the training in DEFAIR. Our PR efforts have had some productive effects as shown by the already developing interest in the RAAF OA programme. However, our public relations programme needs to be extended if we are to convince other potential users throughout the RAAF of what the OA programmes are capable of doing. The areas to which such PR can be extended includes:

a. conducting workshops on how to use OA data,

b. conducting lectures on OA for those who administer surveys, and

c. visiting units for discussion on and inputs to OA surveys.

To accomplish this PR, some allowance will need to be made in the survey tasking for such activities. Currently, almost all the available time of the members in the RAAF OA cell is spent in accomplishing our tasking. If fewer surveys are undertaken, more time can be devoted to attempting to have the data from these surveys used.

CONCLUSION

23. OA is making contributions to the production of trade standards and course design, and the validation of training. However, progress in using OA data has been slow. If OA is to achieve its full potential for use in the RAAF, a greater effort will need to be applied to convincing the potential users of the benefits that can be gained from its use.

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REPORT FROM SPECIAL STUDIES SECTION

Wing Commander N.C. Bleakley, BSc, Dip Ed

1. Special Studies Section in Establishments Division Central Office is established for three officers, one from each Service, and is currently responsible to the Director, Services Establishment Support. Until recently, Special Studies enjoyed Directorate status; previous to that, the Directorate was known as the Directorate of Job Evaluation.

2. The issue of joint-Service activity in occupational analysis was probably addressed for the first time in 1969 when the Personnel Administrative Officers' Committee made recommendations to this effect. The impetus at that time was the need for a better knowledge of job content for job evaluation studies which were intended to lead to a pay system that rewarded the military skills of Service occupations.

3. Co-ordination of OA activities was temporarily halted when the Kerr-Woodward Committee was established to enquire into salary and wage systems of the Services. However, as a result of the Committee's recommendations, a full-scale job evaluation study of officers and other ranks was undertaken.

4. This job evaluation exercise was carried out by the Directorate of Job Evaluation (DJE) during the period 1974-1976. The method employed was known as the Hay System, as it was developed by Hay Associates (Australasia) Ltd. I want to present to you a very brief outline of the principles involved in the Hay System since it is relevant to a session being conducted tomorrow.

5. The Hay System measures each job in terms of three factors:

   a. know-how,

   b. problem-solving, and

   c. accountability.

6. Hay Associates claim these factors are common in varying degrees to all types of jobs and, when measured collectively, are a fair expression of relative job content. The three factors are defined briefly as:

   a. Know-How is the sum total, however acquired, of every kind of knowledge and skill required for competent job performance.

   b. Problem-Solving is the thinking requirement in a job for analyzing, evaluating, creating, reasoning, arriving at and making conclusions.

   c. Accountability is the answerability for action and for consequences of that action.

7. Using a guide chart and profiles, each job is given a score which is the sum of each of the factor scores. The totality of all the job scores forms a job evaluation benchmark scale.

8. Whilst Special Studies Section still has a responsibility to carry out position scoring according to the Hay System, as required, it is only an infrequent task now since the Service Offices have expressed dissatisfaction with the method, especially in its application to Other Rank categories.

9. Defence Central first became closely involved with CODAP when a pilot study was carried out by DJE in the Communication Operatives categories using CODAP techniques. This pilot study was proposed in Sep 74 and there seems to have been some change in the aims between that time and when the report was presented in May 1977. The original aim was to assess the validity and usefulness of a single computerized OA system for the Australian Defence Force. However, in Apr 75, the aim of the project had been changed 'to determine procedures to be adopted in future joint-Service and single-Service OA projects' which is rather a different kettle of fish.

10. The details of the COMMSOP study are not important here. Its significant lies in the fact that several very important issues were addressed for the first time:

a. the problems of delineation of responsibilities between Central Office, the single Services and Computing Services Division;

b. the avenues for liaison;

c. processing delays;

d. the problems of administering a tri-Service study when the three Service OA sections were so geographically separated, especially with RAAF in Melbourne; and

e. the problems of lack of expertise.

11. During the COMMSOP study a CODAP Interface Officer was established in CSD in order to solve some of these problems. Whilst this was a most worthwhile achievement, many of the problems are still evident, living outside his control. Special Studies Section has a responsibility to try to solve them.

THE APPLICATION OF OCCUPATIONAL ANALYSIS FOR DETERMINING OFFICER RANKS

By Dr R.E. Christal

1. Job evaluation is a tough area of research because it is so politically sensitive. No matter what you come out with, people suspect that there has been hanky-panky somewhere along the line. However, the study I shall describe is well documented, and we can defend it in a number of ways.

2. We were asked by the Director of Manpower to determine appropriate grade distributions for all officer utilization fields in the Air Force. That is a challenging job because you cannot go to the hardware store and buy a yearstick that measures grades and lay it alongside all the jobs. Nevertheless, we suggested to the Director of Manpower that, if he could tell us the appropriate grade levels for a sample of jobs, we could use a policy capturing model to determine the appropriate distribution for the entire force. The first important step was to get a sample of job descriptions with which to build a yardstick.

3. At that time, we did not have CODAP, and we did not have job descriptions for every officer in the Air Force. So we had to develop job descriptions for the study. The form for the description was relatively simple. There was a block for job title, location, and organization. Then there was a section where officers wrote a narrative on the duties and tasks performed. In a special comments section, an officer could write in things that might be outstanding about his job, but which could not be inferred from the narrative. Additional information was provided on the present grade authorization, the grade of the supervisor, and the educational level of the incumbent. Then the supervisor of the officer was required to read the description and certify that it was accurate; he was asked also to give his judgment as to the appropriate grade level for that position. We gathered a total of 80,000 job descriptions and then selected a sample of 3,575. We took two descriptions from each authorized rank within each specialty that had six or more officers assigned. Then, for specialties where large numbers of officers were involved, or where the jobs were very heterogeneous, we added more job descriptions to ensure that the stratified sample was completely representative of the Air Force.

4. The next important step was to ensure that the procedures for determining grade levels were publicly defensible. The Director of Manpower believed that the only people who knew the jobs in the Air Force were the officers who worked in that service. So he selected a Board of 22 colonels who were to make judgments about appropriate grade levels for those 3,575 jobs. He wrote to the major commands and gave the specifications for the colonels he wanted for a special assignment at the Pentagon. The specifications were so written that the members of the Board collectively had had experience on almost every type of job in the Air Force. The chairman of the Board was a newly retired three-star general. Board members were instructed by the Director to take off their command hats and to make truthful and unbiased judgments. Members were required

to read and understand each job description before they made their ratings. If someone was not sure what was involved in a job, he could talk to a member who had had experience in that domain. Also, there were people standing by at the Pentagon who were experts in the various discipline areas of science and engineering. The telephone numbers of the incumbents and their supervisors were available also so that members could talk to the actual men on the job. Civilian scientist-observers were used to control the rating board and make sure the ground rules were followed.

5. For each job description, we obtained five independent judgments. The job descriptions were placed in booklets in groups of twenty-five. Members were arranged so that no two officers were rating the same job at the same time. No two officers were allowed to sit next to each other for more than an hour. Everything was being observed to make sure that the judgments were perfectly independent.

6. The grade rating scale had 16 levels as follows:

General	1 level
Colonel	3 levels
Lieutenant Colonel	3 levels
Major	3 levels
Captain	3 levels
All Lieutenants	3 levels

The three levels for colonel were for a junior level, a senior level, and a level of about average. The same applied for the other ranks except for general.

7. We were prepared to abort the entire study if we could not defend the ratings of the Board on the subset of 3,575 jobs. We did some simple analyses to find out if the raters had actually agreed on the grade levels for those jobs. The inter-rater agreement co-efficient was 0.92. This was higher than expected, and suggested that the judges were looking at the jobs in the same manner. It suggested, also, that if we were to repeat the study with an independent board selected in the same way, we would expect to get a high correlation between the two sets of ratings. We had asked the judges to express their feeling of confidence about the grades they were assigning on a three-point scale. For 2,387 positions at least four out of five judges reported the highest level of confidence in their ratings. Then we investigated the sorts of biases the various officers revealed in their ratings. We could not find a single rater or a single category that we could discard because of preferential bias towards a class of job. Another thing we found was that there was no tendency towards a general inflation of grade; the judges said that some jobs were graded too high and some were graded too low. In fact, the Board claimed that almost half of the jobs that were in the sample of 3,575 were not graded correctly. At this point, we felt confident that there must be some meaning to grade and that all the judges had somewhat the same concept. All things considered, we decided that we could accept the Board members' ratings as criteria.

8. Obviously, the Board could not rate 100,000 Air Force jobs, so we had to try another approach. Our goal was to determine the factors that the judges considered in making their ratings, then weigh their factors together to assign the same grade levels to jobs as the Board. That is a policy capturing model. First, we considered all the possible job requirement factors that may have entered into the deliberations; eg, management, communication skills, judgment, and so on. Historically, these factors have been used in many executive evaluation programs. Then we added such factors as the position the job occupied in the organizational structure. Altogether, we generated about 200 different predictors. Then we obtained ratings on the factors from independent groups of lieutenant colonels and majors, and computed an equation which would predict the grades assigned. We simplified the equation by minimizing the number of factors and maximizing its face validity. This made the equation more easily understandable. At this point, I shall define several of the factors. For example, management had to do with the level, the variety, and the complexity of the management controls. Planning involved the scope and the significance of what was being planned as well as the time-span involved. Special training and work experience were not concerned with professional military education but with experience that had to be obtained before a person could perform a specific job adequately. Judgment and decision making had to do with the importance and the independence of the decisions, the likely impact of those decisions. Communication skills involved the level of the person or agency involved and the impact that poor communication might have on the organization. The final equation contained only nine factors, which are listed in Table 1. The first seven factors are the primary definers of grade.

Variable	Validity
Management	.75
Planning	.71
Special Training & Work Experiences	.45
Judgment & Decision-making	.60
Communication Skills	.63
Level of Organization	.53
Level Within Organization	.53
Mean Grade Rating by Field Judges	.89
Supervisors Judgment	.63
Final Equation	.92

Table 1. Final Policy Equation

The equation had a validity of 0.92. Eighty-two percent of all jobs in the sample were pin-pointed to a third of a grade with the equation. Errors were randomly distributed across pilots, engineers, scientists, and so on. So although we though we might have to develop one equation for science and engineering and another for pilots, it did not turn out that way. Evidently, in the minds of Air Force officers, grade has a universal meaning.

9. After establishing the equation, we gathered data on 10,000 more jobs. Then we applied the equation to determine the appropriate grade level for each job. At this point, it was obvious that the Air Force could not implement the results without some compromise. There are two ways to determine grade authorizations. You can support an orderly career progression so that every officer has some opportunity of being promoted at the various career points. This requires a model showing what the distribution of grades has to be in order to support the careers' plan for the whole force. But what we are discussing are the appropriate grade levels for jobs based upon job content and responsibility levels. The question is: do you want to pay a colonel to do a job that a major could do?

10. Now, I shall discuss some of the findings at random. We found that we had too many lieutenant colonels. There were 3,156 pilots and navigators in flying jobs. If we had implemented the Board's modifications, 2,346 of those lieutenant colonel jobs would have been downgraded to major or below. You do not need a lieutenant colonel to fly a plane. On the other hand, in the operations area, many jobs were grossly undergraded. Instead of 135 lieutenant colonel jobs, there should have been 413. This indicated that there were a lot of majors and captains in Air Force operations who have very responsible jobs. Finally, in the science and engineering areas, there would have been a gross upgrading of jobs. Now, I shall mention one of the payoffs based upon the study. The Air Force was able to get Defense Department approval for 2,000 more authorizations at the major level. This helped overcome a promotion barrier for 2,000 captians who would not have been promoted otherwise.

11. Since the completion of the study, we have developed benchmark scales with job titles on each factor. Table 2 shows part of the benchmark scale for the management area.

Management	The level of executive, and managerial skills required in the job. Consider the complexity, variety, and level of the activities which are directed, organized, co-ordinated, controlled, commanded, or evaluated.
LEVEL 9:	Director of Budget, HQ Major Air Command Commander, Combat Support Gp (Overseas) Wing Commander, Tactical Control Wg (Overseas)

LEVEL 5:	Traffic Management Officer, Transportation Sq Base Communications Maintenance Officer, Communications Sq Missile Combat Crew Commander, Strategic Missile Sq
LEVEL 1:	Clinical Psychologist, USAF Hospital Psychiatric Social Worker, USAF Hospital Helicopter Pilot Single Rotor, Air Base Sq

Table 2. Management Area Benchmark Scale

This shows the top level (9) the middle level (5) and the bottom level (1). It will be noted that helicopter pilot is at the bottom on management, but on other factors, this job would be near the top.

12. To summarize, I think that this was an honest and a valuable study. It gave the Air Force a clearer concept of grade, and defined job requirements based on job content and responsibility level.

PRODUCTION AND VALIDATION OF TRADE STANDARDS AND COURSE TERMINAL OBJECTIVES

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INTRODUCTION

1. Effective management of a workforce depends, in part at least, on managers' having an accurate knowledge of the tasks that their personnel are expected to be capable of performing. The RAAF's main method of collecting this information is through its ongoing CODAP occupational analysis (OA) programme. The data from these OA programmes are used to produce two series of important documents; trade specifications and course graduation requirements. Both of these documents enable management to determine the tasks that their members are expected to be capable of performing and the minimum proficiency that their members are required to achieve in each task. The following paragraphs describe these documents.

2. Trade Specifications. The RAAF sets trade specifications to ensure that designated tasks are performed at the required level of proficiency. A series of RAAF publications contains the Trade specifications for all RAAF musterings up to and including the rank of corporal. The trade specification encompasses:

a. a general description of the mustering,

b. entry requirements and method of entry,

c. a career plan,

d. the tasks comprising the trade standard, and

e. the trade tests which must be passed at each level.

Most of the effort required to produce the trade specification for a mustering goes into producing the trade standard. A trade standard details those tasks that an airman is expected to perform at each rank level from aircraftman to corporal and also the associated performance level in each task. The proficiency levels of the tasks are minimum acceptable levels for entry to a mustering or rank/proficiency level. The trade standard also incorporates many of the skills acquired once the member has completed his or her basic trade training course.

3. Course Graduation Requirement. The course graduation requirement is structured into two parts as follows:

a. Part 1 Course Details and Special Requirements, and

b. Part 2 Course Terminal Objectives.

Part 1 identifies the course, specifies the aim of the course, states the elegibility conditions and graduation status of trainees, stipulates any constraints of a policy nature, and specifies the appointment of a sponsor. The main concern of this paper is with Part 2 of the graduation requirement. Part 2 lists the course terminal objectives which specify the training goals in student oriented terms. Course terminal objectives are statements of what the trainee must be able to do, and how well, to graduate from the course. Given this information, all concerned with the training system - managers, instructors, students, examiners and employers - should know precisely what a course is designed to achieve.

4. Having described these two documents, I will now discuss the production and validation of what I believe is the most important part of each - the trade standards and the course terminal objectives.

AIM

5. The aim of this paper is to:

a. Describe the content and uses of trade standards and course terminal objectives.

b. Explain the method devised for producing these documents from OA data.

c. Explain why this method is sometimes difficult to apply.

d. Outline advantages of having OA data available during the production of trade standards and course terminal objectives.

DEFINITION OF TERMS

6. As some members of the audience may not be familiar with all the RAAF terms used in this paper, I will define these terms before proceeding to cover the aims of this paper.

a. Trade. A trade is a group of related jobs. It is a classification into which an airman is placed comensurate with previous civilian employment or RAAF training. The term is used synonymously with the term mustering.

b. Job. A job refers to what an individual airman does as part of his usual employment in the RAAF workforce. A job is composed of a number of related duties.

c. Duty. A duty is a large segment of a job, and is composed of a number of discrete related tasks.

d. Task. A task is a discrete action or specific unit of work.

e. Trade Test. A trade test is a means by which the performance of an airman is evaluated for either entry to a trade or for advancement. The trade test is designed to assess the capability of an airman to perform tasks covered in the applicable trade standard. Trade tests usually comprise a practical and a written test.

f. Career Plan. Annex A illustrates the general career plan for RAAF airmen.

TRADE STANDARDS AND COURSE TERMINAL OBJECTIVES

The Trade Standard

7. What the Trade Standard should Include. As laid down in the applicable RAAF publication, the trade standard is to include:

a. All those tasks, and only those tasks, an airman is expected to perform at each rank level.

b. Those subjects and skills the knowledge or application of which is necessary for performance of mustering tasks but which are not apparent from task statements.

8. As an example to illustrate the content of sub-paragraph 7b, suppose a task for one of the radio trades is "Diagnose faults in radio receivers" Here a knowledge of the subject 'electronics' is self evident and would not be stated in the trade standard. However, whilst doing the task the airman must apply the relevant safety precautions; these can be made more explicit by listing.

9. What the Trade Standard Should Exclude. With the exception of Technical Administration, Safety, and Aircraft Ground Handling (tasks common to all technical trades), the Trade Standard will contain information relating to one mustering only. Generally, it will exclude:

a. the subjects of promotion examinations,

b. skills and knowledge gained through special courses limited to selected airmen,

c. the peculiar requirement of individual locations,

d. variations of skill and knowledge arising from the peculiarities of particular equipment types, and

e. contingency tasks. (1)

(1) The trade standard should not, for example, allocate a sergeant's tasks to a corporal, in case there should not be a sergeant available. The aim of the trade standard is to establish minimum acceptable levels of skills. It is not intended to provide for every conceivable eventuality.

10. Uses. The trade standard informs section commanders of the performance they can reasonably expect from new or newly promoted members. These managers are then in a position to assess fairly the member's work, and so ensure he gains additional on-the-job training and experience to enhance his or her effectiveness. The trade standard is also available to the member to indicate the range of tasks he is expected to carry out, and the performance expected on each task. This information is of assistance to the member when he or she is preparing for a trade test.

Course Terminal Objectives

11. What Should be Included. A prime requirement of course terminal objectives is that they accurately reflect the skills and knowledge required for the task on which members of the trade are likely to be employed in the first two or three years after graduation. Thus, the course terminal objectives must be based on a thorough knowledge and understanding of the jobs for which the trainee is being prepared. As these jobs may change before the trainee graduates, an allowance must be made for forthcoming technology associated with new aircraft or equipment which will be entering the service. In addition, skills the graduate would require in an emergency or wartime situation should be considered for inclusion in the course terminal objectives.

12. What Should be Excluded. As mentioned previously, the emphasis in a course terminal objective is on what a trainee must be able to do at the end of his training course. Objectives or practical skills that are essential to the achievement of a terminal objective are not included in the course terminal

objectives, as these would be obtained through task analysis during the syllabus construction. For example, if 'Select and operate appropriate fire fighting equipment in a simulated situation' is a course terminal objective, then objectives such as 'State the different classes of fire and the appropriate method of extinguishing them' would not be included with the course terminal objectives as this knowledge is essential to the performance of the stated terminal objective. However, this cognitive skill is an enabling objective and would be listed in the syllabus of training.

13. Uses. The training school composes the syllabus of training for the course from the course terminal objectives contained in the graduation requirement for the mustering. As course terminal objectives state only the end product of training, they need to be scrutinized to identify the enabling skills and knowledge needed to be acquired by the trainee before he performs task at the required proficiency level. The process of identifying these enabling objectives is commonly called task analysis. The syllabus of training can be used by all involved with training (managers, instructors, students and examiners) to determine the detailed course content.

PROCEDURE DEVISED FOR USING OA DATA TO PRODUCE TRADE STANDARDS AND COURSE TERMINAL OBJECTIVES

14. Before outlining the procedure developed by the RAAF OA Cell to assist in the production of trade standards and course terminal objectives, I will briefly outline the methods the RAAF uses to collect its OA data and the format of the data used to produce these documents. This outline will assist in the explanation of the methodology developed.

OA Data Collection

15. In the RAAF, the OA survey booklets are normally administered to over 80 percent of the mustering being surveyed. Each members selected to complete the survey booklet fills out a background information section, checks the task he performs and indicates how his worktime is distributed across the tasks in his job. In addition, about 45 senior non-commissioned officers (Flight Sergeants and Sergeants) rate tasks in the inventory on one or more of the following factors: task learning difficulty (TLD), consequence of inadequate performance (CIP), and need for immediate performance (NIP). The data after collection are then analysed using the suite of CODAP programmes into the required outputs.

Procedure - Trade Standards

16. Now, let's look at one of these outputs with the purpose of producing these two documents. The printout used lists the tasks performed by ACs, LACs, and CPLs ranked in order of the percentage of ACs who perform them. The printout also lists any ratings on task factors that have been collected. Table 1 presents

an extract from such a printout for the Photographer Trade.

TABLE 1

TYPICAL PRINTOUT USED FOR PRODUCTION OF TRADE STANDARDS AND COURSE TERMINAL OBJECTIVES

TASKS	PERCENT PERFORMING			TLD	NIP
(FIRST PAGE)	AC	LAC	CPL		
Clean equipment after chemical mixing	90	79	70	2.8	6.3
Dry or glaze projection or contact prints	70	63	65	3.3	5.7
Prepare B/W film for processing in dark room	60	68	70	4.4	6.1
Plot characteristic curve using densitometer	55	58	34	6.5	7.2
(MIDDLE PAGE)					
Process B/W prints by machine	35	16	30	4.7	5.4
Expose air film negatives on 10"x10" projection printer	25	26	4	6.2	5.1
Copy photographs using process camera	20	32	39	6.1	5.3
(LAST PAGE)					
Install or remove type B air camera	0	5	9	6.3	4.6
Perform equipment schedule checks	0	0	26	5.3	5.4
Process colour transparencies manually	0	5	13	6.6	6.4
Service type A magazine	0	5	13	5.7	5.7

17. The first column of values gives the percentage of ACs performing each task as part of their normal job. It also gives the probability that an AC Photographer will be required to perform each of the tasks listed. You will observe that tasks on the first page of the printout are all encountered by at least

55 percent of AC Photographers. As there is a high probability that an AC photographer will encounter each of these tasks, one would expect to find most of these tasks contained in the AC trade standard for Photographers and also in the terminal objectives for the Basic Photographer's Course. In contrast, the last page of the printout lists tasks encountered by relatively few ACs and, as most ACs are unlikely to encounter these tasks, one would expect that few of these tasks would be included in the trade standard (or in course terminal objectives). In fact, many of the tasks on the last page should be excluded from the trade standard purely on the grounds that they reflect peculiar requirements of individual locations. (Certainly, it would not be cost effective to train all students in these tasks as fewer than five percent of graduates will encounter them in their first posting after graduation.)

18. The procedure that has been recommended for adoption in the production of trade standard is as follows. Firstly, a trade standards review team, composed of at least five SNCOs or WOFFs, under the guidance of an officer from Trade Standards and Trade Testing Section, uses the data together with policy and trade specialists inputs to determine tasks that should be included in the draft trade standard. This is achieved by the review team using the percentage of ACs performing the task as a guide to the probability that an AC will be required to perform the task. The team then considers whether the task should be included in the draft trade standard at AC level or not. If the concensus of opinion from the members of the review team is that all ACs should be capable of performing the task, then it would be included in the draft trade standard for ACs. Otherwise, the task would not be included in the draft. The task is then considered in turn for inclusion in the draft trade standards for LACs and CPLs.

19. Next the review team determines the proficiency levels required for each task for the three ranks. The task factors (task learning difficulty, consequences of inadequate performance, and need for immediate performance) together with the trade experience of the members of the review team are used to determine these proficiency levels.

20. The resulting draft trade standard is subsequently examined by the specialist staff officers for the trade to ensure that it not only meets the existing requirements but also incorporates any task or trade structure changes likely to affect the mustering before the next trade standards review.

Procedure - Course Terminal Objectives

21. Before outlining the procedure recommended for producing course terminal objectives, I will explain the relationship between the two documents. There should be a close relationship between trade standards (which list the tasks members are expected to perform) and the course terminal objectives (which indicate the training given to prepare members for performing tasks). This

relationship should be especially close between the AC trade standard and the terminal objectives for the basic trade training course. (In these circumstances, when the member graduates off course as an AC, he should have attained the AC trade standard.)

22. The procedure recommended for producing course terminal objectives directly related to a trade standard is for a team (preferably consisting of some members who helped produce the trade standard) to produce the course terminal objectives from the appropriate trade standard. They will determine if there are:

a. any tasks in the trade standard for which formal training is not needed (because the required proficiency is a pre-requisite for course selection, the tasks are better learned on-the-job, or for which formal training would not be cost-effective);

b. any tasks on the LAC or CPL trade standard for which it may be more cost-effective to give training on the basic course. (Thus some overtraining may be justified if it eliminates the need for future courses);

c. any additional training topics required as a result of new technology equipment about to be introduced into the RAAF; and

d. any other tasks that should be introduced according to the current policy regarding the mustering.

Problems Encountered Using Devised Procedures

23. Although the application of the procedures for using the OA data to produce trade standards and course terminal objectives greatly simplifies the task of producing both documents, experience has shown that the procedure is not as simple to apply in practice as had been hoped. The task of producing the documents is made very difficult by the high heterogeneity found in most RAAF musterings (particularly the technical musterings). For example, in the OA survey on the Instrument Fitter mustering Table 2 we found that for corporals all tasks of a technical nature were being performed by fewer than 44 percent of the mustering. With such heterogeneous musterings, the process of deciding which tasks should be included in the trade standard (or for that matter the course terminal objectives) is more difficult than with a homogeneous mustering (such as the Photographer mustering OA survey data for Corporals shown in Table 3). In addition, the trade review panels, when faced with these difficult decisions, prefer merely to update the old trade standard from their experience rather than attempt to use the available OA data.

TABLE 2

EXAMPLE OF HETEROGENEOUS MUSTERING: TOP 30 TASKS IN TERMS OF PERCENTAGE OF INSTRUMENT FITTER CORPORALS PERFORMING

TASKS	PERCENT PERFORMING
Participate on parades	84%
Perform base rostered duties other than duty crew	73%
Clean section	73%
Allocate personnel to duties or tasks	64%
Raise demands for equipment	56%
Give on the job training	56%
Amend publications or orders	53%
Secure buildings	49%
Search equipment catalogue for item identification number	48%
* Inspect pitot static systems	43%
* Inspect pitot heads	42%
* Carry out after flight checks	42%
* Prepare aircraft for flight	41%
* Service pitot static system	41%
* Inspect pitot static plumbing	41%
Control security of section buildings	40%
Complete appropriate section of maintenance documents	39%
* Fire SLR at a fixed target on an open range	39%
* Troubleshoot pitot static plumbing	38%
* Inspect oxygen regulators	38%
* Service tacho indicator	38%
Insert line amendments into service publications	37%
Move or park aircraft	37%
Marshall aircraft	36%
* Remove or install tacho indicators	36%
* Refuel or defuel aircraft	35%
* Inspect instrument panels	35%
* Inspect thermocouple temperature system	35%
* Service clocks	35%
* Troubleshoot gyromagnetic compass system	34%

* Note: Only these tasks (16 out of 30) are of a technical nature. This means that all other technical tasks in the Instrument Fitter mustering are performed by fewer than 35% of Corporals.

TABLE 3

EXAMPLE OF HOMOGENEOUS MUSTERINGS: TOP 30 TASKS IN TERMS OF PERCENTAGE OF PHOTOGRAPHER CORPORALS PERFORMING

TASKS	PERCENT PERFORMING
Participate on parades	96%
Carry out cleaning of working area	91%
Maintain security of section buildings	78%
* Trim projection on contact points	78%
* Maintain photographic job register	74%
Participate in production conference within section or unit	74%
* Prepare B/W chemistry for printing in dark room	70%
* Prepare B/W film for processing in dark room	70%
* Clean equipment after chemical mixing	70%
* Process B/W film manually	70%
* Clean negatives before or during printing	70%
* Prepare or maintain photographic records	70%
Carry out rostered duties	70%
* Unload hand held camera	70%
* Select safelight filter	65%
* Expose print ground negatives on contact printer	65%
* Wash projection or contact prints using tray set-up or rotary print washer	65%
* Dry or glaze projection or contact prints	65%
* Sort projection or contact prints	65%
Raise photographic work order	65%
Maintain section workload or production tables	65%
* Stamp and title photographic prints	65%
* Maintain negative register	65%
* Act as photographic adviser	65%
Counsel subordinates on job-related problems	65%
* Monitor usage of photographic materials	61%
* Store working chemicals	61%
* Prepare for, set up and take group photographs excluding PR photographs	61%
* Prepare for, set up and take identification photographs	61%
* Prepare for, set up and take PR photographs	61%

* Note: 22 out of 30 tasks are technical. After 30 tasks there are still 60% of corporals performing tasks.

24. The RAAF is a very small force (22,500) compared with the air forces of other nations, and yet the RAAF has to provide engineering and maintenance support for a wide range of operational roles. In turn, these roles are spread over a wide range of aircraft types, weapons systems, and supporting systems. Within this environment tradesmen are considered to be fully negotiable, ie, all corporal Instrument Fitters can be posted to any type of aircraft or other system which is established for the trade and rank for work at any depth of maintenance. This accounts for the high heterogeniety in many RAAF musterings.

25. The flexibility the RAAF enjoys in posting members is made possible as a result of the high training investment it carries; any drastic reduction in the range of taks in the trade standard or course terminal objectives would reduce this posting flexibility. If this flexibility is required, then it must be paid for in terms of extra training costs. Cost-effective training can probably only be achieved by accepting the concept of training members specifically for the job they will do on their first appointment. The courses resulting from this approach would be shorter and more practically oriented and would give the RAAF more productive service (for every training dollar spent) from its first tour (and also its only tour) airmen. However, the concept of cost-effective training is in conflict with that of posting flexibility. What we in the RAAF should be trying to do is balance the need for flexibility against the cost of overtraining when deciding the contents of trade standards (and hence trade training courses).

26. Another one of the problems that has arisen has been caused by the course terminal objectives' being produced directly from OA data concerning the trade without reference to the relevant trade standard. As the same form of printout is used to produce the course terminal objectives as the trade standard, and the general procedures adopted for selecting tasks for inclusion in each document are similar, one would expect to find a readily discernable common content in these documents. However, this relationship is difficult to see.

27. The reasons why the required relationship cannot be readily seen is attributable to the fact that different teams work independently. Although each team uses the same OA data to help produce each document, the concensus decisions made on whether to include a task in draft documents or not is based on the opinions of members. In addition each teams tends to group several tasks in the draft document together under the one general heading and the classification used depends on the team.

28. We in the RAAF OA Section believe that if the required relationship between trade standards and course terminal objectives is not only to exist but also readily be seen to exist, then it is essential that the production of these documents be closely co-ordinated. Unless their production is closely co-ordinated, the documents could easily end up being incompatible.

29. Unfortunately, in the RAAF there are two schools of thought as to which documents should be produced first and considerable discussion has taken place on this issue without its being resolved. Further, the additional effort required to solve this issue would only result in the production of these documents being delayed and is, therefore, not warranted particularly as most of the objections from both sides can be overcome and the required relationship between the documents obtained if both documents are produced concurrently by the same team. (This suggestion would also save some duplication of effort by both teams and, hence, would also result in financial savings).

Benefits of Using OA Data

30. Despite the problems associated with using OA data as outlined above, there have been, and will continue to be, positive contributions from OA to trade standards and training. OA data have enabled those involved in producing these documents to make decisions based on what the members of a musterings were actually doing at the time of the survey. In the past these decisions had to be made in the absence of such reliable information and, as far as training courses were concerned, the decisions erred on the wide of conservatism. (That is, when course content was determined, extra training was often included just to be on the safe side). Decisions made under these circumstances have resulted in some unnecessary and misdirected training being included in the course content.

31. Providing CODAP OA data that tells us precisely what workers were doing on the job at the time of the survey, has enabled our training and trade testing system to be more job related, helped to identify areas of overtraining (where the training was not nor was likely to be used), and enabled policy makers to make decisions concerning the responsibility of the mustering.

32. Finally, if the RAAF decides to continue with overtraining in some areas to maintain posting flexibility, then it is important that those involved in determining course content have some measure of how much extra flexibility will be obtained for the additional cost involved. OA data on the mustering can help by indicating how much extra training will be required to provide the required degree of posting flexibility.

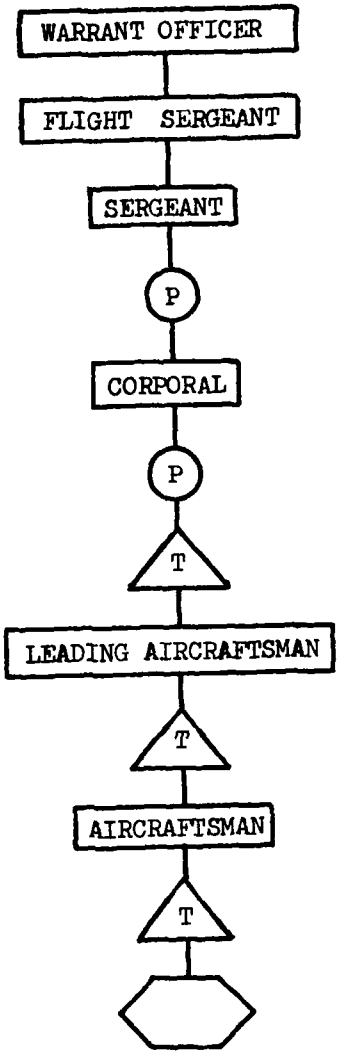
CONCLUSION

33. This paper has outlined the method used by the RAAF to produce trade standards and course terminal objectives and explained the difficulties that have been experienced in applying the method to many of the RAAF trades. One of these difficulties is the requirement to balance the need for flexibility in posting members against the cost of overtraining the members. In spite of these difficulties, CODAP OA data has been positive contributions to trade standards and training. By providing accurate data on which decisions can be made, OA has helped remove much of the 'guess work' out of the copilation of trade standard and

course terminal objectives. This information will provide management with an accurate knowledge of the tasks their personnel are expected to be capable of performing.

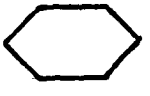
34. When the RAAF acquired the complete CODAP package in 1974, the full potential of OA was realized, subsequently some progress has been made in developing methods of using OA data in the RAAF. The task that lies ahead is to convince others of the benefit to be gained from using CODAP data.

CAREER PLAN



PROMOTION EXAMINATION

TRADE TEST



BASIC TRADE TRAINING COURSE

PROPOSED METHOD OF JOB EVALUATION FOR PAY PURPOSES FOR "OTHER RANKS" JOBS

Wing Commander J.W.K. Fugill (Ret) B.A. M.Ed

1. The evaluation of jobs for pay purposes is a conceptually difficult and controversial area of management. Anyone proposing an entirely new approach to job evaluation not only sets himself an almost unattainable goal, but tends to alienate even those people whose interests he is supposed to represent. Not the least distasteful aspect of this procedure is the implication that those who support the existing system are conceptually wrong - headed and somewhat less perspicacious than they ought to be. In redress, this paper is dedicated to those position description writers and evaluators who did their best with the present system during the long night of 1974, 1975 and 1976.

2. Following the publication of the Job Evaluation Report for Other Ranks in July 1976, a review of the existing system was undertaken. When it became clear that piece - meal modifications would not satisfy the Services' needs, research was begun on a replacement system, henceforth known as the Australian Defence Force System.

AIMS

3. The aims of this paper are to:

a. explain the rationale for a job evaluation system that is specific to the military industry, and

b. describe the conceptual framework of the proposed system.

RATIONALE FOR A MILITARY JOB EVALUATION SYSTEM

Future Need for Job Evaluation

4. In the future, the Services could create new employment categories or restructure existing categories in response to changes in technology and operational procedures. Those actions would create a need for supplementary reviews of pay and allowances. To ensure consistent application of the Kerr/Woodward principles, the job evaluation system will have to fit the new categories onto an existing benchmark scale.

5. In addition, there is the possibility that a comprehensive job evaluation review could be initiated at any time. In that event, the Services should have researched and defensible system with which to properly represent the interests of their members. In this sense, this proposal is a contingency plan capable of implementation with the minimum of inconvenience.

Traditional Evaluation Systems

6. A review of traditional evaluation systems (including the twelve proposals submitted in competition with Hay Associates) revealed a number of major deficiencies.

a. The sample of jobs that can be surveyed economically represent only a small percent of each category. In a category comprising numerous job-types, it is very difficult to decide which position description is a "typical" representation of a category as a whole.

b. Evaluation factors have a measure of face validity, but little statistical support as to reliability. Thus, although Know-How, Problem Solving and Accountability have a superficial attractiveness, how do we know that they are appropriate?

c. Where factors are weighted, the derivation of the weights is not explained. The Hay Associates contact did not state what weight were being applied for the three factors Know-How, Problem-Solving and Accountability. After the 1976 evaluation exercise, an attempt was made to infer how the factor scores had been distributed. The general pattern that emerged was as follows:

Know-How	- 70%
Problem-Solving	- 12%
Accountability	- 18%

The over-riding importance given to Know-How in determining the final score is obvious. Noteworthy also is the correlation co-efficient of 0.95 between the Know-How scores and the Total Scores for each category. Such a high overlap suggests that essentially the same benchmarks scale could have been derived without the cost of evaluating and scoring the Problem-Solving and Accountability factors. Stated another way, the benchmark scale which contributed to the work value study was basically a Know-How scale.

d. The scoring is usually done by hand. When large representative samples are involved, this becomes a laborious and time-consuming task.

e. No provision is made for report the extend of agreement between the scorers. Therefore, managers do not know what degree of confidence can be placed on the scorers' decisions. In the case of the Hay scoring exercise, the three scorers may well have been highly idiosyncratic in their views on the nature of military work.

f. The systems are designed primarily for the civilian workforce.

g. Because the systems are manpower intensive, the cost of broadly representative surveys tend to be prohibitive. For example, the preparation of a single position description will cost between $50 and $100. This is an expensive investment, especially as the position descriptions have little value for other management applications.

Definition of the Benchmark Scale

7. The proposed job evaluation system will measure the relative worth of all employment categories within the Australian Defence Force. Relative worth refers to the contribution made by a category to the achievement of Service aims. The arrangement of the categories on a scale from lowest relative worth to highest relative worth will constitute the benchmark scale. This scale will be one source of guidance in pay determinations.

Evaluation System Criteria

8. From the review of traditional systems and from comments made by Service Offices, the following points emerge as likely criteria to be met in the Australian Defence Force System.

9. Sample Size. Category samples size must be sufficiently large to cover all significant job-types. The calculated mean score for the sample is then a fair representation of a category's relative worth.

10. Evaluation Factors. Evaluation factors must have face validity for "military skills" categories as well as for categories closely related to civilian trades. In addition, the factors must be such that reliable data can be gathered economically.

11. Factor Weights. Applied factor weights must be derived systematically from the broadest possible concensus of opinion.

12. Scoring Methods. Scoring methods must be systematic, computerized, and subject to verification.

13. Judgement Analysis. When judgements are involved, the levels of agreement must be reportable.

14. Costs. Costs must not be prohibitive; this implies minimum use of manpower and maximum use of support systems.

15. Military Orientation. The Services must be satisfied that the system measures the unique contributions made by sailors, soldiers and airmen in achieving the Services' aims.

16. In addition, it is desirable that the data be suitable for other management applications.

THE PROPOSED SYSTEM

17. This proposal is based on a pilot study done in 1978 with the co-operation of the three Service Offices. However, the methods used are not new. The main ingredients are job descriptions from the data bank, a package of programs (CODAP) and a policy-capturing model designed by Christal in 1966.

18. The following paragraphs are a simplified version of the pilot study report. The basic steps in the proposed system are as follows:

a. Select job evaluation factors.

b. Score job descriptions which represent each category.

c. Apply the agreed weights for each factor.

d. Calculate the final score for each factor.

e. Place the categories on a benchmark scale.

Selection of Job Evaluation Factors

19. For the choice of factors, there are two basic criteria.

a. The factors must be conceptually acceptable to the Armed Forces Industry; and

b. The factors must be so defined that consistently reliable information can be gathered at the task level.

20. So that the pilot study could be completed before this seminar, several factors were chosen without complete agreement from the three Services. Complete agreement is a possibility, but hardly likely!

21. The first chosen factors were Task Difficulty and Consequences of Inadequate Performance. Task difficulty appears to have considerable overlap with Know-How in the Hay System. Both factors require recognition of how many bits of knowledge, and the depth of knowledge required for satisfactory performance. Consequences of Inadequate Performances is conceptually related to Problem Solving and Accountability. But more importantly, previous experience in the USA and Australian services shows that work supervisors give highly reliable information on these factors at the task level.

22. The second pair of factors were Hazard and Environment. These were a unanimous choice of the Services. Fortuitously, in 1977 the RAN had tested these factors at shore installations and on board ships. The reliability of the judgements was found to be almost as high as for Task Difficulty and for Consequences of Inadequate Performance.

Scoring Category Job Descriptions

23. Table I shows the standard method of scoring Task Difficulty on a hypothetical job description for a group of Girl Fridays.

TABLE I - SCORING TASK - DIFFICULTY

Task	Percent Time Spent (1)	Relative Task Difficulty(2)	Cross Products(3)
Answer telephone calls	5	1.2	6
Type letters	70	4.5	315
Prepare refreshments	15	2.0	30
Maintain file register	10	3.1	31

Sum of Cross Products = 382

The Percent Time Spent values are the averages for this group of workers (Column 1). Relative Task Difficulty values are provided by work supervisors (Column 2). The Cross Products (Column 3) are added to give an Average Task Difficulty score.

24. To complete this hypothetical case, the scores for the four factors are shown in TABLE II.

TABLE II - FACTOR SCORES

Task Difficulty	382
Consequences of Inadequate Performance	250
Hazard	150
Environment	125

In most traditional system, the next step is to add up the four scores and accept that the final benchmark score is 870. The critical question is whether this procedure gives a result which correctly balances the relative import nce of the factors. This question leads to the possibility of deriving factor weights in a more systematic way.

Derivation of Factor Weights

25. The proposed method of deriving weights uses a simple version of a "policy capturing" model. A group of judges, defined as being "expert" make independent decisions on the relative importance of factors. The policy of the group is then captured by computer analysis and presented as an easily understood equation. The best explanation of the method is contained in an allegory called Selecting a Harem - And other Applications of the Policy-Capturing Model (Christal, 1968).

26. In the pilot study, a sample of 40 category job descriptions (PTE equivalent) was selected from the data bank. Fifteen judges at the Major (E) and Lieutenant Colonel (E) level were asked to rank - order the jobs (from 1 to 40) on:

a. the four evaluation factors, and

b. a criterion factor called Relative Worth

27. With the Relative Worth factor, the judges were asked to consider the jobs in the broadest possible context and to rank - order them on their relative worth to the Australian Defence Force. The intention was that the judges' deliberations would extent beyond the parochial interests of their own Services.

28. The computer was then given the judges' decisions on both the four evaluation factors and the criterion rankings on Relative Worth. The resulting equation took the following form.

Relative Worth = .61 x Consequences
+.21 x Environment
+.19 x Difficulty
+.01 x Hazard
-.63 (Constant)

This equation represents the considered opinion of the "Experts" from the three Services.

29. To test the accuracy of the equation, a comparison was made between the judges rankings and the ranking derived from the equation (Annex A). In regard to the general accuracy of the equation, the correlation co-efficient between the two sets of values is .97. How this correlation may be improved upon is suggested at Annex B.

30. The factor weights were derived from a wide consensus of "expert" opinion. The agreement between the 15 judges was high.

TABLE III - CO-EFFICIENTS OF AGREEMENT

Task Difficulty	.98
Consequences of Inadequate Performance	.97
Hazard	.95
Environment	.97
Relative Worth	.95

This suggests that high confidence can be had in decisions derived from these judgements.

Calculation of Category Scores

31. To illustrate the application of the factor weights, the hypothetical case of the Girl Friday group is carried to its logical conclusion.

Relative Worth = .61 x 250 (Consequences)
+.21 x 125 (Environment)
+.19 x 382 (Difficulty)
+.01 x 150 (Hazard)
-.63 (Constant) = 252.2

This means that the Girl Friday group falls on the job evaluation scale at the 252nd benchmark.

32. The calculation of the final scores for about 250 categories will be done systematically by computer. Several small categories, for which full occupational surveys could not be justified, would be assessed by a Joint-Service work party.

Finalization of Benchmark Scale

33. In determining the final placement of all categories on a benchmark scale, the computer-produced scores would be reviewed by a group of service representatives. In keeping with the theme of capitalizing on the widest possible concensus of expert opinion, this group might comprise as many as thirty people. The rules for decision making would have to be prescribed vigorously before deliberations began.

DISCUSSION

Relationships Between Factors

34. The relationships between the factors require comment. Does the pilot study suggest that the factors are suitable? Table IV shows the correlation co-efficients between the pairs of evaluation factor scores.

TABLE IV - EVALUATION FACTOR CORRELATIONS

	Task Difficulty	Consequences of Inadequate Performance	Hazard	Environment
Task Difficulty				
Consequences of Inadequate Performance	.64			
Hazard	.44	.70		
Environment	.49	.59	.81	

The high correlation between Hazard and Environment confirms most people's commonsense notions about the two phenomena. The debatable point is whether both factors need to be included in the system.

35. Table V shows the correlation co-efficients between each evaluation factor and the criterion Relative Worth.

TABLE V - CORRELATIONS - EVALUATION FACTORS AND RELATIVE WORTH

Evaluation Factors	Relative Worth
Task Difficulty	.76
Consequences of Inadequate Performance	.94
Hazard	.75
Environment	.73

The very high correlation between Consequences of Inadequate Performance and Relative Worth suggests that the two factors are thought of synonymously by military judges. Therefore, in any weighted equation on Relative Worth, it would be expected that Consequences of Inadequate Performance would be weighted heavily. This did, in fact, happen.

The Accuracy of the Equation

36. The essential question is whether the equation can be accepted at face value. Is it possible that the co-efficient of .97 is spuriously high? Without going into the technical complexities of the question, two validation exercises are suggested.

37. The first action is to assemble a second independent group of officers to provide judgements on the Relative Worth criterion factor. The resulting data could then be matched with the evaluation factor data provided by the first group of judges. From this matching procedure, a new equation could be developed to validate the original equation.

38. A second possible action is to apply the equation to a set of category job descriptions not used in the original pilot study. This would confirm whether the equation is universally accurate in covering all military categories.

Problem of Scaling

39. An outstanding problem is that of preparing reliable factor benchmark scales across all categories. The matter at issue is that a task reported to be of high relative difficulty in one category is deemed to be of low relative difficulty in another category. The inclusion of sets of common tasks in all inventories for comparative purposes is not as administratively easy as it might appear. Expert opinion will be sought on this matter.

SUMMARY

40. The thrust of this paper is that the existing job evaluation system should be replaced by a computer based system tailored to the special needs of the military industry.

41. The criteria to be met are as follows:

a. There must be large representative sampling to cover all job-types adequately.

b. Evaluation factors must provide reliable information.

c. Factor weights must be derived systematically.

d. The scoring system must be computerized.

e. An analysis of the judges' decisions must be possible using standard statistical procedures.

f. The costs must not be prohibitive; furthermore, the system must provide pay-offs in other areas of management.

g. The Services must be satisfied that the system, with its military orientation, will properly represent the unique contributions made by sailors, soldiers and airmen to the achievement of Australian Defence Force aims.

42. From the 1978 pilot study, the following conclusions emerge.

a. The evaluation factors Task-Difficulty, Consequences of Inadequate Performance, Hazard and Environment are such that reliable inform tion can be gathered from work supervisors.

b. Category job descriptions derived from CODAP data provide adequate information for a factor scoring exercise.

c. Weights to be applied to the factors can be determined by a group of "expert" judges.

d. The scoring is computerized.

e. The system criteria can be met with considerably less cost and turbulence than with a traditional system. As a bonus, numerous other applications are possible using the same data.

43. In addition, the system is sufficiently flexible to permit the addition of new factors or the deletion of obsolete factors.

44. There are two matters requiring further investigation. First, there is a need to validate the original weighed equation. Secondly, a method will have to be settled upon to prepare task benchmark scales for each selected factor.

45. As a final point, it is unlikely that Service Offices will find every aspect of this proposal to their taste. However, they might contemplate what the future holds if they persist with an existing system which is so obviously unsuitable for evaluating military "other ranks" categories.

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ANNEX A

RELATIVE WORTH RANKINGS

Category	Judges' Rankings		Equation Rankings	
Steward	3.2	1	3.9	2
Telephone Operator	4.0	2	7.4	6
Education Assistant	5.8	3	3.3	1
Musician	5.9	4	6.5	4
Clerk	6.9	5	6.0	3
General Clerk	7.3	6	6.6	5
Clerk Admin	9.5	7	8.1	7
Litho Platemaker	12.5	8	11.0	8
Motor Transport Driver	12.9	9.5	12.4	9
Medical Assistant	12.9	9.5	15.4	12
Sheet Metal Worker	14.3	11	17.2	13
Rigger Parachute	15.3	12	18.8	16
Driver	15.9	13	15.1	11
Metalsmith	17.6	14	17.8	15
Blacksmith	17.9	15	17.4	14
Cook	18.3	16	13.8	10
Mech Electrician	19.1	17	19.1	17
Fireman	19.9	18	20.2	18
Motor Transport Fitter	22.4	19	20.1	19
Mechanics Vehicle	22.9	20	21.4	20
Marine Technical Hull	23.2	21	22.8	21
Weapons Mechanic	23.5	22	22.9	22
Fitter Electrical	23.7	23	24.1	24
Electronic Electrical Power	24.5	24	26.5	27
Operator Radio	25.0	25	24.8	26
Signalman	25.2	26	24.5	25
Marine Technical Propulsion	25.3	27	26.8	28
Marine Technical Propulsion Diesel	25.2	28	27.7	30
Operator Keyboard Cypher	26.3	29	23.3	23
Fitter Airframe	27.9	30	30.3	36
Electrical Fitter	29.1	31	27.8	31
Electronic Technical Weapons	29.7	32.5	28.4	32
Airframe Fitter	29.7	32.5	29.7	35
Fitter Engine	29.8	34	32.1	39
Armament Fitter	30.5	35	30.2	37
Electronic Technical Communications	30.9	36	28.7	33
Radio Technician Air	31.1	37	28.8	34
Rifleman	31.3	38	26.9	29
Engine Fitter	32.0	39	32.0	38
Electronic Technical Weapons Systems	32.1	40	32.3	40

ANNEX B

NOTES ON IMPROVED PROCEDURES

1. The pilot study shows that the weighting policy of military judges can be captured. Any replication of this study, such as a formal joint-service exercise, would require the same standards of rigour if the final result was to be comparable. The following discussion is directed primarily towards an enhancement of the accuracy of the policy capturing model.

Size of Job Descriptions

2. In the pilot study, it was administratively convenient to use shortened job descriptions on a single sheet of paper. However, for the official exercise, it might be more satisfying for some judges to have the complete description available.

Number of Categories Represented

3. Although most judges were satisfied with 40 job descriptions, better results are likely with a broader representation of "military skills", aircrew and sea-going categories. Currently, there is a limit on the range of categories available from the data bank.

4. The recommendation that a larger set of categories be used is based on the well researched principle of "context effects". This principle states that more accurate rankings are obtained when a job is judged against numerous different types of jobs. A set of 80 - 100 jobs is suggested.

Administration of Formal Weighting Exercise

5. Whereas the judges in this study did the ranking exercise at their own convenience, more formalized procedures would enhance the reliability of the judgements. The procedures might include the following:

a. The judges, assembled in a common work area, would receive identical sets of job descriptions and a briefing on interpretation of occupational information.

b. Additional information, such as the Manual of Army Employments, would be available for perusal.

c. The judges would be permitted to discuss factual matters with each other, but the final decision would be their own.

Composition of the Judging Panel

6. The 15 judges in the pilot study made no claims to be especially knowledgeable about Australian Defence Force employments. However, the panel should be, by definition, "expert". This means that Service Office representatives should have the broadest possible knowledge of other rank categories.

7. In regard to the number of judges, Table I indicates that 30 judges (3 services x 10) would provide uniformly high reliability on each factor.

TABLE I - Agreement Between Judges

Raters / Factor	Calculated	Estimated				
	1	15	20	25	30	35
1. Job-difficulty	.742	.977	.984	.989	.989	.991
2 Consequence of Inadequate Performance	.656	.966	.974	.979	.982	.985
3 Hazard	.567	.952	.961	.968	.974	.977
4 Environment	.647	.965	.974	.979	.982	.985
5 Relative Worth	.544	.947	.961	.968	.974	.977

8. Reported Levels of Confidence. The judges took an average six hours to complete the ranking exercise. Thirty-nine percent of them said that the job descriptions had too little detail; sixty-one percent said that they were "about right". In regard to the number of jobs in the set (40), seventeen percent said that they would have had more confidence in their rankings if the set had been longer. When asked to show on a seven-point scale the level of confidence they had with each factor, judges responded as shown at Table II.

TABLE II - Levels of Confidence

Factor	Mean (15)
1 Job Difficulty	5.0
2 Consequences Of Inadequate Performance	4.4
3 Hazard	4.6
4 Environment	5.0
5 Relative Worth	3.0

These mean values show that the judges, as individuals, had morerate to low confidence in themselves. However, as shown in Table I, the statistical reliability of the group as a whole was very high on each factor. The methodological moral to be drawn is that the individual judge's reported feeling of confidence is not a good guide to practical group performance.

COMMENTS BY SERVICE REPRESENTATIVES ON THE PROPOSED METHOD OF JOB EVALUATION FOR PAY PURPOSES

1. Following the presentation by WGCDR Fugill, representatives of the single-Service Offices were invited to make formal comment.

Commander W.L. Taylor, Directorate of Naval Industrial Policy

2. CMDR Taylor opened the comment from the Directorate of Naval Industrial Policy by stating that the proposal was only part of a far wider area in the Defence Force. It could not be the complete solution.

3. He felt that much more data was needed than was evident in the pilot study in order to provide a solution to the unquestionable weaknesses of the Hay system. He felt that the proposed method seemed capable of taking a wider sample of jobs, which was a weakness in the Hay method. Hopefully, it could more fully reflect the unique aspects of jobs in a military environment. However, the proposed method did not provide the total solution; it merely set out to establish in-Service skill relativities.

4. CMDR Taylor felt that, having graded employments on the basis of agreed factors, the major task of quantifying the results in financial terms remained. He wondered who would translate the results into pay level terms and whether the proposed system was compatible with established industrial principles.

5. CMDR Taylor felt that the extent to which the CODAP package could accommodate environmental employment changes was not clear. He questioned whether any weighting process could satisfy the variations in, say, hazard or job difficulty at sea vis-a-vis the environment ashore. He asked how the method could accommodate the strictly naval skills categories where the true skills can only be demonstrated at sea and where employment ashore varied from the primary duties at sea.

6. In summary, CMDR Taylor made five points:

   a. Providing that the Minister for Defence would agree that the proposed method was a suitable vehicle for the future, his Directorate saw merit in further in-depth studies of the proposed system.

   b. There was a need for some system to improve on the Hay System.

   c. The need for a more formalized methodology was evident.

d. The need for a contingency plan for the future was agreed.

e. It must be recognized that any such system did not provide the total solution. The final arbiter had to be external to an in-Service benchmark scale.

Major L.R. Wilson, Directorate of Service Conditions, Army Office

7. MAJ Wilson stated that the Directorate of Service Conditions, Army Office, saw job evaluation as an aid - simply one factor in the pay determination process. Other factors, albeit ones difficult to quantify, were intra and inter Service relativities, community standards, importance to the Service, hazard, stress, and attraction and retention.

8. He saw job evaluation as attempting to measure clinically an employee's accomplishment, or from management's point of view his contribution, by using one factor common to all employments ie. skill. To this extent job evaluation had two advantages:

a. By using a factor common to all employments it is able to relate one employment to another in a consistent standardized form.

b. It allows management's pay determinations to appear fair to all.

9. He saw job evaluation's disadvantage in its inability to assess all the variables an individual considers part of his personal accomplishment or another's contribution. In addition, skill may not be the dominant factor in assessing contribution, in spite of the Kerr-Woodward philosophy that rates of pay should reflect the actual tasks carried out and responsibilities carried.

10. He felt that whilst the principle of 'pay for what you do' may have application in the trades area, care should be exercised in applying it in the military skills area. In the military skills area it had to be modified to mean pay for experience, proficiency gained through training, and the potential to carry out operational functions. There was a distinct possibility of underestimating the skills of the military skills soldier as much of that skill was invisible for long periods.

11. MAJ Wilson stated that the Directorate of Service Conditions wanted a system with the following requirements. There should be two scales, one for trade skilled employments and one for military skills. Employments on one scale would not be directly comparable with employments on the other except, perhaps, at one point. He foresaw eventually a number of scales, each representing a cluster of like employments eg. driver employments, survey and printing employments. In the technical trades area these might contain employments from the three Services.

The relationship between the clusters of employments should be left to industrial relations analysts who would take into account other factors such as political and socio-economic considerations, attraction and retention factors, and the essential importance of the employments in achieving the Army's role.

12. In summary, MAJ Wilson said that he hoped to instil some caution in applying job evaluation processes to pay fixation.

Mr A. Chapman, Directorate of Personnel Services, Air Force Office

13. Mr Chapman stated that many of his points had already been covered. He raised three main problems, each of a technical nature:

a. He had doubts whether there would be enough survey information available to carry out the exercise.

b. He felt that carrying out exercises on a tri-Service basis would be a real problem.

c. He could not see how to account for a new mustering - when a survey would be carried out, for example, to determine its place on the scale.

14. In summary, Mr Chapman felt that the proposal could be one input into the system but it should not drive it. It could perhaps fill gaps.

PROPOSAL TO ESTABLISH A BENCHMARK SCALE OF JOB WORTH

Comments By Dr R.E. Christal

1. Dr Christal drew attention to the similarities between the proposal and the USAF Officer Grade Requirements (OGR) Study that he had outlined previously in the seminar. He felt that similar problems had been encountered. In the OGR, the task was to capture from the minds of those in the military establishment their concept of the meaning of "grade"; in the proposal under scrutiny, the problem was to capture from people in the Defense establishment their concepts of job worth, without being initially concerned with what that worth actually was. If a Board could obtain good inter-rater agreement on the worth of every job category, then the basic problem was solved; the Board's joint opinion was the answer.

2. Factors and an equation were needed for two main reasons, which were quite separate issues:

a. When the Board disbanded, there was a need to have some mechanism to fit new categories into the scale in the same way that the Board would have done.

b. There was usually a need to show that the Board's evaluations were based on factors that had meaning to other people.

3. Dr Christal then turned to the specific proposal presented by WGCDR Fugill.

4. His first concern was whether the officers doing the rating fully understood the jobs they were rating. He felt that extreme effort should be made to ensure that every member of the Board knew exactly the nature of the jobs he was rating. In this respect, he recommended against using abbreviated task descriptions because the tasks appearing at the top of a job description are often the housekeeping tasks; the ones that really separate jobs often appear towards the middle of the job description. He advised having on call experienced NCOs from every occupation to resolve any doubts on the Board members' minds. He commented that, if this was a US exercise, he would feel more nervous if he had officers rating enlisted jobs than if he had officers rating officer jobs. He saw this proposal as being particularly challenging because of its tri-service nature.

5. Dr Christal criticized the method by which the Board rated according to the factors and then later according to worth. He was sure that induced correlation must have resulted. The very fact that the Board had four factors presented to them was subtle indication that these were the probable factors that accounted for worth. One Board (called the Criterion Board) should concentrate on only one problem ie, rating each category according to their perception of worth. Other sources should be used to obtain the factor information needed to work up the equation used to explain the Criterion Board's ratings.

6. Dr Christal felt that more factors should be used, even though some would undoubtedly prove redundant. At least their redundancy could then be demonstrated. It was possible to establish a minimum subset of factors which were economical to deal with in the final equation.

7. Dr Christal then drew attention to the need to ensure that the equation was statistically stable. There needed to be sufficient criterion observations with relation to the number of factors being rated to avoid the statistical problem of "over-fitting".

8. In his next point, Dr Christal stressed the need for a thorough analysis of the Board's ratings. It was important to see not only the overall inter-rater agreement about jobs, but also the agreement about each specific job. If there was violent disageement about a job, this job could be put aside for the moment while factor information was developed on the jobs where there was agreement. After the resultant, it could then be applied to the jobs where there was disagreement to see where those jobs actually fell in terms of the criterion. In other words, where there was agreement the direct ratings of the Board could be used, and where there was disagreement the equation could be used. If there was still disagreement, at least the debate was narrowed; it might be, for example, that the argument revolved around only one factor.

9. Further to this point, Dr Christal emphasized that, if there was disagreement, if was important to find out exactly the sources of this disagreement. In order to find out if there was differences in perspective, the raters might be divided for analysis into Army, Navy, Air Force, for example, while the jobs might be divided into support, maintenance, and so on. It was important to find out how every Board member rated every job in every category compared with how every other Board member rated them. Furthermore, the Board members should know that this would happen.

10. In summing up, Dr Christal felt that the major contribution of CODAP was to provide good information to the Criterion Board so that every member understood fully each category he was rating. The equation would be used to help resolve problems where there was disagreement and to bring new occupations into the system.

REVIEW OF MILITARY JOB-SATISFACTION RESEARCH USING OCCUPATIONAL INFORMATION

By Dr R.E. Christal

1. The US Air Force is interested in studies of job satisfaction because of the evidence that dissatisfied workers tend to leave the service at the first opportunity. As you know we no longer have a military draft in the United States, and we are experiencing a significant reduction in the size of the 18-21 year old population from which we draw our volunteers. All of the US Services are experiencing problems in filling positions. There are also problems associated with high attrition rates and low re-engagement rates which make force maintenance even more difficult.

2. At the present time, the Air Force Human Resources Laboratory (AFHRL) is undertaking research on process models of personnel turnover. These studies will involve continuous tracking of large numbers of personnel throughout their Air Force careers to observe and measure factors related to their attitudes and career decisions. Since this research thrust is just getting underway, I will not describe it in detail today. Rather, I will discuss a series of past studies, most of which have made use of occupational data and the CODAP analysis system.

3. Our past research on job satisfaction has involved one main long-term stream, as well as a number of short term studies on specific problems. The long-term effort is broken into five phases, as follows: (a) a review of the state-of-the-art; (b) definition of the dimensions of job satisfaction; (c) measurement of the satisfaction of personnel in each occupation on each defined factor; (d) establishing the relationship of each factor to turnover in each occupation; and (e) determining the changes in jobs and job conditions which will reduce turnover in each occupation. A review of the job satisfaction research conducted by AFHRL thru 1976 is available (Gould, 1976), along with the results of a review of 400 civilian and 284 military publications (Tuttle & Hazel, 1974).

4. Results of the Tuttle and Hazel review confirmed that: (a) job satisfaction is related to turnover, absenteeism, and sick calls; (b) the relationship between satisfaction and performance is inconclusive; (c) job satisfaction is multi-dimensional; (d) no satisfaction measurement instruments were found which covered all major aspects of military work environments; (e) job satisfaction is a function of the interaction between work factors and personnel needs; (f) very few studies have dealt with specific job content data -- utilizing instead, subjective reports of job attitudes; (g) very few studies have been longitudinal; and (h) theories of satisfaction tend to be oversimplified with overlapping, frequently conflicting research findings.

5. After a thorough review of the literature, work was undertaken on identifying and developing measures of all of the dimensions of job satisfaction in the military environment. An instrument called the

Occupational Attitude Inventory (OAI) was constructed and administered to 3000 enlisted personnel. The OAI contained 348 attitude items which were designed to cover the 35 hypothesized job satisfaction dimensions listed in Column 1 of Table 1. Data on these items were intercorrelated and factor analyzed. Thirty-five factors were identified in the solution and are reported in the second column of Table 1. Based on subsequent analyses, the OAI was trimmed down to 200 items and administered to an additional 10,000 case sample. These data are being analyzed at the present time to determine their relationship with turnover rates.

Hypothesized Dimensions	Number of Original Items	Rotated Factors
Achievement	7	Additional Duties
Activity	8	Assignment Locality
Air Force and Unit Policies and Practices	18	Base Housing and Eating Facilities
Assignment Locality	17	Benefits Provided by Base Facilities
Authority	4	Control Over Others
Co-workers	9	Co-workers
Creativity	10	Economic Security
Economic Security	4	Family Attitude Toward Job
Importance	8	Independence
Independence	9	Information on Policies and Procedures
Interest	9	Job Security
Job Change	7	Knowledge of Results
Job Design	10	Leave and Time-Off Policies
Knowledge of Results	7	Morality of Work
Optional Social Contact	7	Opportunities for Social Contact
Pay and Benefits	12	Opportunity to Stay Busy
Performance Evaluation	8	Personal Growth and Development
Personal Growth and Development	9	Physical Demands of Job
Physical Safety	6	Physical Safety
Physical Work Environment	13	Physical Work Environment
Promotion Opportunity	8	Promotion Opportunity
Recognition	9	Recognition
Required Social Contact	10	Required Verbal and Written Coordination
Responsibility	10	Service to Others
Service to Others	8	Social Contact (non-peer)
Social Status	11	Status in Civilian Community
Sufficiency of Training	12	Sufficiency of Training
Supervision Received-Human Relations	15	Supervisor's Competence
Supervision Received-Technical	9	TDY Costs and Conditions
Tools, Equipment, and Supplies	8	Tools, Equipment, and Supplies
Utilization	8	Travel Requirements and Opportunities
Value of Experience	8	Unit Safety and GMT Programs
Variety	9	Value of Experience
Work Schedule	15	Work Itself
Supervisory Duties	18	Work Schedule
Unclassified	8	
Total	348	

Table 1. Hypothesized 35 Job Satisfaction Dimensions and 35 Empirically Derived Varimax Rotated Factors

6. Table 2 presents example attitude items defining two of the 35 factors. A full description of the Occupational Attitude Survey and of the factor analysis study is given in a publication by Dr. Bruce Gould (Gould, 1978).

The Work Itself

Challenge provided by your job

Amount of interesting work performed

Feeling of accomplishment

Importance of work

Use of abilities

Variety of tasks

Supervisor's Competence

The way your supervisor handles his subordinates

The ability of your supervisor to make decisions

The way your supervisor trains his men

The technical competence of your supervisor

Your supervisor's knowledge of the way your job is done

Table 2. Example attitude items under two job satisfaction factors

7. While we do not have score values for all occupations on the 35 OAI factors, we do have values for most occupations on three items normally collected in the background section of job inventories. These are: Job Interest; Utilization of Training and Talents; and Sense of Accomplishment. Survey results indicate that there is a wide variation on levels of satisfaction on these items, both within and between occupations. For example, Table 3 reports the percent of individuals at the 3, 5 and 7 skill levels in a number of occupations who report that their training and talents are being used "very little" or "not at all". Notice the wide differences between occupations. For example, at the journeyman level (5 skill level) 54% of those working in the Pavements Maintenance specialty reported little or no utilization of training and talents, while only 6% of those working in the Dental Laboratory specialty reported they were being poorly utilized.

AFSC	Career Ladder	N	Skill Level		
			3	5	7
551X0	Pavements Maintenance	1,059	63	54	15
276X0	A/C Control and Warning	1,689	63	51	27
461X0	Munitions Maintenance	1,590	58	50	21
402X0	Aerospace Photo Systems	261	-	56	35
671X3	Disbursement Accounting	1,354	58	45	NA
611X0	Supply Services	949	53	36	12
303X0	Auto Tracking Radar Repairman	708	51	39	20
234X0	Precision Photoprocessing	836	47	42	15
811X0	Security	3,617	46	36	9
443X0G	Minuteman Missile Mechanic	1,032	44	46	18
204X0	Intelligence Operations	926	43	39	20
915X0	Medical Materiel	1,022	43	26	7
811X0A	Dog Handler	559	10	24	2
903X0	Radiology	548	9	12	11
432X0	Jet Engine Mechanic	1,622	9	8	6
305X3	Electronics Computer Repairman	1,055	7	14	13
607X0	Loadmaster	1,773	6	12	5
324X0	Precision Measuring Equipment	1,212	6	7	8
322X1	Weapons Control Systems	1,285	5	6	3
272X0	Air Traffic Control	1,518	2	5	7
982X0	Dental Laboratory	486	0	6	3

Table 3. Rank Ordering of Ladders by Percent Claiming Talents and Training are Utilized "Very Little" or "Not at All"

8. It is difficult to determine the relationship of job satisfaction factors with turnover in each occupation, especially with cross-sectional data. Some individuals in a cross-sectional sample will spend one to three years in service before reaching the end of their contract. While we know their attitudes at one point in time, we have no information on subsequent changes in their jobs, job conditions, or attitudes. However, we have developed a method to infer the probable power of satisfaction factors to predict re-engagement decisions in each occupation using cross-sectional data. It involves use of complex regression analysis to predict factor levels as a function of months of military service. The inference is made possible by including in the analysis sample only those cases with the same number of years of service commitment. Figures 1, 2 and 3 present plots of expected job interest factor values as a function of months of service for individuals in three occupational categories.

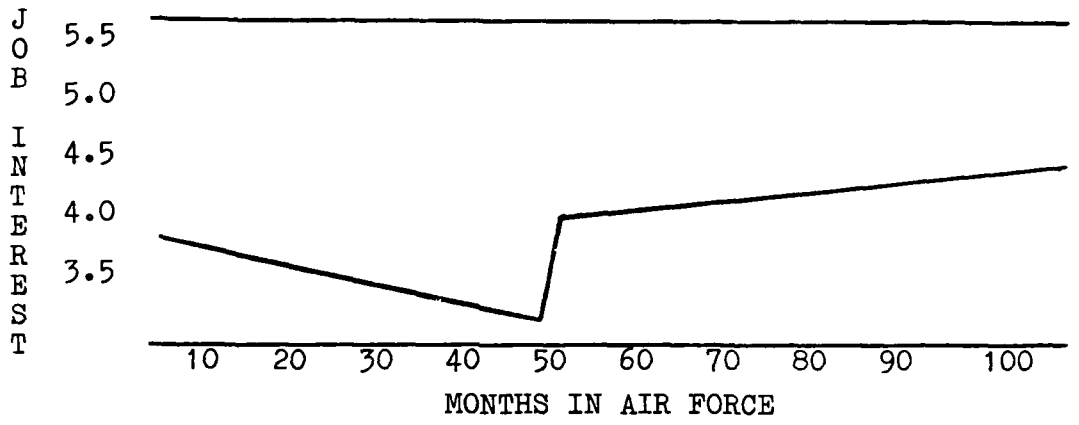

Figure 1. Pavements Maintenance

9. Figure 1 presents data for personnel working in the Pavements Maintenance Occupation. It can be seen that the job interest of workers in the first 48 months of service begins low, and continues to drop throughout the period. At this point, there is a residualization process and only those who have re-engaged are included in the sample. The data indicate that those who have re-engaged are those who find the work in this occupation interesting, since the regression line shows a sharp jump at the 48-month point. The data also indicate that those who re-engage find their work in their second term to be progressively more interesting with the passing of time.

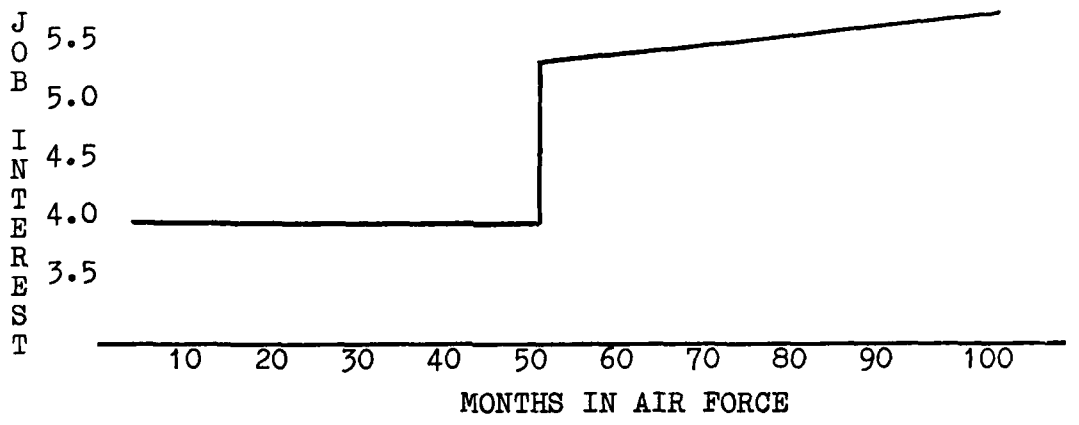

Figure 2. Precision Photoprocess

10. Figure 2 presents data for the Precision Photoprocessing occupation. Individuals in this occupation indicate a moderate and steady job interest level in their first enlistment. However, there is a very strong indication that only those who find the work extremely interesting tend to re-engage. For those who stay on, they find their work progressively more interesting.

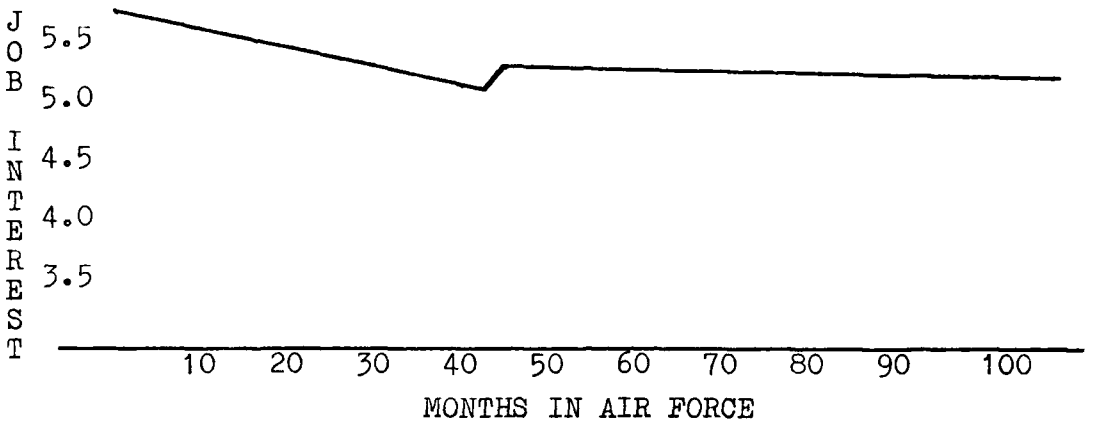

Figure 3. Programmer

11. Figure 3 presents data for personnel in the Computer Programming occupation. The data indicate that nearly all individuals in this occupation find their work extremely interesting, although there appears to be some deterioration in interest during the first 48 months. There is no indication that those who re-engaged find work in this area any more interesting than those who left the service.

12. While the data presented in Figures 1, 2 and 3 are based upon cross-sectional data, a recent study has been conducted which suggests that the data probably can be interpreted as if they were longitudinal (Gould, 1976). This being the case, one might conclude that making the job of computer programmer more interesting is not a reasonable approach to improving the re-engagement rate. There is essentially no "impact gap" on the regression curve in Figure 3 between first and second-term personnel. Perhaps if the curve for "perceived pay differential for military and civil sector jobs" were plotted for this occupation, a large impact gap would be found at the 48-month point, indicating that an increase in pay might be a solution to high turnover. Figure 2 shows a very large impact gap for the Precision Photoprocessing occupation. The data suggest that moving some interesting tasks performed in the second term into first term jobs might reduce turnover. Figure 1 suggests very serious problems in the Pavements Maintenance occupation. Not only is there a large "impact gap," but neither first nor second term personnel find work in this occupation very interesting. It appears that this occupation would be a good candidate for intensive investigation.

13. Data in Table 3 reveal that 63% of the apprentices and 54% of the journeyman working in the Pavements Maintenance occupation report that their talents and training are being utilized "very little" or "not at all." Data in Figure 1 indicate that first term personnel in this occupation find their jobs very dull. We conducted an in-depth analysis of this specialty to see if we could explain the reported attitudes. First, we reviewed the official occupational description and found that it appeared to describe meaningful work. The major duties defined in this description are as follows:

a. Constructs, maintains, and repairs airfield pavement, surface mats and membranes, roads, streets, walks, parking areas, and open storage areas; aircraft revetments and associated draining.

b. Inspects, maintains, and repairs railroad beds and tracks.

c. Operates concrete batch, asphalt batch, rock crushing, and other fixed or mobile plant installations.

d. Samples and tests soils, asphaltic concrete, portland cement concrete, and crushed gravel.

e. Performs other pavements maintenance functions.

f. Assists in the use and handling of explosives.

g. Supervises pavements maintenance personnel.

14. Next, we analyzed the entry-level training course and found that it covered 210 hours of instruction on what appeared to be meaningful tasks. The major elements in the course outline are as follows:

a.	Orientation, soils, and railways	60 hours
b.	Rigid pavements; prefabricated surfaces and shelters	60 hours
c.	Flexible pavements and vegetation control	60 hours
d.	Soil chemicals and explosives	30 hours

15. Finally, we reviewed the job description for first term workers computed by the CODAP system, using occupation survey data. Figure 4 lists the first 17 tasks on this description, which accounted for more than one-third of all worktime. The problem immediately became apparent.

Task	% Performing	% Time	Cum % Time
Mow or edge grassed areas	64.29	7.70	4.95
Wash or clean equipment	75.18	4.97	8.69
Control weed growth	56.17	5.53	11.80
Trim or remove trees or shrubs	51.09	5.25	14.48
Service motorized equip, W/fuel, oil, etc	50.12	4.28	16.62
Plant trees, shrubs, grass or flowers	45.76	4.34	18.61
Water or irrigate vegetation	32.69	5.65	20.46
Haul Loose const. mat., such as sand or gravel	55.57	3.13	22.20

Task	% Performing	% Time	Cum % Time
Dump loose const. mat., such as sand or gravel	55.81	3.04	23.89
Operate air compressors	57.99	2.88	25.56
Fertilize vegetation	36.56	4.54	27.22
Lubricate operating equipment	41.16	3.74	28.76
Dig trenches or ditches by hand	47.70	3.21	30.29
Tighten loose bolts or attachments	42.49	3.59	31.81
Clean, lubricate, or sharpen tools	45.52	3.26	33.30
Sweep paved surfaces	38.50	3.28	34.56
Install or repair fences	42.74	2.83	35.77

Figure 4. Job Description - Pavements Maintenance/ Equipment Operator (55IXO N-826 First Terms)

Workers were spending very little of their worktime on the major tasks for which they received training. Most of their worktime was being spent on mundane tasks, such as mowing grass.

16. One important point is that there were a few individuals who reported that they found their work interesting and their talents well utilized. We used the CODAP system to produce a job description for these individuals and found that they were performing more difficult tasks, a greater variety of tasks, and fewer gardening tasks. In fact, they were performing tasks which were very much in line with those for which they had received training and which were listed in the official occupational description.

17. We went into the field to confirm the information collected with the job inventory used in the occupational survey to see if we could uncover reasons for the way individuals were being utilized. We found that the CODAP job descriptions were extremely accurate. We also were able to uncover the factors giving rise to the underutilization of military personnel. The major problem was that most meaningful jobs were being contracted out to firms in the civilian sector. This was due in part to the unavailability of construction equipment, such as paving machines. We also found that side-by-side civil service workers were many times being assigned the more interesting tasks. Finally, we found that the cost-accounting system discouraged managers from assigning new personnel to complicated tasks, since managers tended to be rewarded more for the cost effectiveness of their operation than for generating military skills.

18. At the end of the investigation, we were able to list alternatives for management, based on solid information. If the Air Force did not need military skills in the Pavement

Maintenance occupation, then it should completely eliminate this occupation from the military structures and have such work performed by civil service or civilian contract personnel. However, if military skill were needed, the obvious need was to contract out the non-military functions (such as grass mowing and vegetation care) and assign the meaningful pavements maintenance tasks to military personnel. Three years after these recommendations were made, we resurveyed the Pavements Maintenance occupation. We were able to demonstrate that military personnel were performing fewer grounds tasks and a lot more work in line with training and official job descriptions. At the same time, while job satisfaction had fallen off in many Air Force specialties, the satisfaction of pavements maintenance workers had increased significantly.

19. As mentioned earlier, it is not easy to determine the relationship between job satisfaction factors and re-engagement decisions. The regression model approach described above may help identify the most likely factors, but a safer approach would be through long-term longitudinal studies. However, even if we have the important factors in each occupation, a more consequential question is what can you do to change jobs and job conditions to increase worker satisfaction. The typical approach has been job intervention studies in which experts literally go into organizations and modify jobs and conditions. Pre-tests and post-tests are administered to demonstrate increases in job satisfaction. However, studies of this nature are very expensive to conduct and may not provide good answers to the question. The job redesign exercise upsets organizations, and there is a danger that improvements in reported job satisfaction may simply be a reflection of the so called "Hawthorn effect" by which individuals are happier simply because they are a part of an experiment. There is another approach which I feel has many advantages. It becomes feasible in the military environment because jobs and job conditions change as individuals are reassigned. It simply involves the administration of job inventories and job satisfaction inventories to a sample at two points in time. Regression analysis is employed to account for changes in job attitudes as a function of changes in jobs and job conditions. This approach is inexpensive, does not disrupt operations, and is not subject to the Hawthorn effect.

20. While on the surface, it would seem that more satisfied workers would be the most productive workers, there is very little evidence that such is the case. Evidently, even many dissatisfied workers continue to be productive until they have an opportunity to leave the service. We have a systematic research program which is designed to measure and improve the productivity of individuals and organizations. However, even though it relies heavily on occupational survey data and CODAP analyses, it is distinct from our job satisfaction research program, so I will not describe it today.

21. In summary, insuring the job satisfaction of military workers is important, since dissatisfied workers tend to leave the service at the first opportunity. Data collected with occupational surveys and analyzed with the CODAP system are useful in identifying the sources of dissatisfaction in the job environment which can be addressed by management.

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APPLICATION OF OCCUPATIONAL INFORMATION TO JOB SATISFACTION STUDIES IN THE AUSTRALIAN DEFENCE FORCE

Wing Commander J.W.K. Fugill (Ret)

INTRODUCTION

1. Until this decade, job satisfaction studies in the Australian Defence Force were severely limited by the lack of a comprehensive occupational data bank. As this limitation no longer applies, it is timely to ask - what practical steps are being taken to use job satisfaction data for the betterment of our respective Services? This question is largely rhetorical and the answer is embarrassingly obvious.

2. A second possible limitation is a lack of knowledge about methods in this extremely complex area. Our Guest Speaker has given us an over-view of the range of possible approaches. However, the aims of this paper are modest by comparison but pertinent to the Australian military scene.

AIMS

3. The aims are to:

   a. describe methods for identifying work groups which report low job satisfaction; and

   b. suggest ways in which occupational information can be applied to enhance job satisfaction.

4. The general theme of the paper is that the prompt identification of existing and potential job satisfaction problems will alert managers to the need for timely remedial action. The underlying premise is that, irrespective of whether re-engagement quotas are being filled now, the Services must work for the future by building up a reputation for being honest, concerned and active in promoting the happiness of its members. This does not imply that military workers have an inalienable right to happiness. But it does suggest the possibility that high job satisfaction and operational effectiveness are compatible and worthwhile aims.

IDENTIFICATION OF LOW SATISFACTION WORK GROUPS

5. As a starting point, job satisfaction data will be used from the Communications Operatives study conducted in 1975-76. In the original report (November 1977), the aim was to propose methods of interpretation rather than to write prescriptions.

Employment Categories

6. The twelve employment categories included Signalman and Radio Operator from the Navy; Operator Keyboard and Supervisor Communications Centre from the Army; and Telegraphist and Telephone Operator from the Air Force. To the extent possible, each category was represented by servicemen and servicewomen in a variety of roles.

Data Collection

7. A total of 1500 job incumbents, representing a 75 percent sample, was asked to provide information on tasks performed in their current jobs. In addition, they gave information on thirty background variables. Of particular importance to this paper are the variables, job interest, utilization of training, and re-engagement intentions. Respondents indicated on a five point relative scale, their attitudes to their current jobs.

Data Analysis

8. The mean values for job interest and utilization of training were calculated for various categories, ranks and job-types. These mean values are called job satisfaction indices and, although they must be interpreted with caution, they are useful indicators of relative organisational health.

9. As a routine preliminary to the analysis, the basic job-type diagram and associated job descriptions were prepared.

Employment Category Problems

10. Identification of Category Problems. The twelve employment categories were arranged from high to low job interest (Table 1). The arrangement is based on the responses from all 1500 incumbents in the sample.

TABLE 1: CATEGORY BY JOB INTEREST

Category	Position	Job Interest
SPV COMCEN	1	4.36
OP KEYBD & CIPH	2	3.99
TELEG	3	3.96
TPRINOPC	4	3.88
RO	5	3.87
TPHONEOP	6	3.78
TELSOPC	7	3.72
OP KEYBD & RAD	8	3.69
OP RAD	9	3.68
WRRO	10	3.63
SIG	11	3.58
OP KEYBD	12	3.51

This Table shows that the OP KEYBD category reported the lowest job interest. A study of the job description for that category (Annex B) provides a means for the manager to detect:

a. individual task performance which is highly repetitive;

b. high incidence of task performance outside the area of specialization; and

c. when read in conjunction with the syllabus, low utilization of training.

Having identified the problem area, the specialist may seek to resolve the problem.

11. Resolution of Category Problems. Category problems having a bearing on job satisfaction can be complex and their resolution involves consideration of many factors. The specialist officer, having considered the factors, may elect to:

a. implement more frequent job rotation at the section level;

b. ensure that highly trained incumbents are not employed out of category for long periods (but for some low-level specialties, out of category employment may be beneficial);

c. in conjunction with personnel staff, plan postings to increase the variety of work experience; or

d. restructure the employment category.

Ranks Problems

12. Identification of Rank Problems. As a general rule, reported job satisfaction should rise with rank because less contented personnel will have withdrawn themselves at re-engagement points or their re-engagement will not have been recommended. If reported job satisfaction does not rise with rank, then there is something seriously wrong within the category. Table 2 suggests, prima facie, that the situation in 1975 was satisfactory. However, specialist officers may decide that action is required when a category's figures are significantly below the means shown in Table 2.

TABLE 2: JOB INTEREST BY RANK

Navy		Army		RAAF	
SMN/WR	3.5	SIG	3.5	AC/ACW	3.8
AB/SWR	3.6	LCPL	3.5	LAC/LACW	3.7
LSMN/LWR	3.8	CPL	3.9	CPL	3.7
PO/POWR	3.8	SGT	4.3	SGT	4.0
		SSGT	4.3		
CPO/CPOWR	4.4	WO2	4.5	FSGT	4.1
WO/WOWR	4.7	WO1	4.4	WOFF	4.3
ALL RANKS	3.7	ALL RANKS	3.8	ALL RANKS	3.8

13. Resolution of Rank Problems. Possible courses of action to solve rank problems include those listed in paragraph 11. In addition, the rank structure may require re-evaluation to ensure that work performed is consistent with nominated status. This means that we seek to ensure that Sergeants are not doing the work of Privates.

Job Types Problems

14. Identification of Job-Type Problems. During the routine analysis of the 1500 jobs, twenty-four distinct job-types groups emerged. In Table 3, the job-types are arranged in order from high job interest to low job interest.

TABLE 3: JOB-TYPES ARRANGED FROM HIGH TO LOW JOB INTEREST

Position	GP	Job Interest	Rank Equivalents *			
			PTE-LCPL	CPL	SGT-SSGT	WO2-WO1
		HIGH				
1	283	4.65		6	9	5
2	442	4.33	16	4		
3	373	4.32	8	11	10	5
4	035	4.27	10	21	15	16
5	083	4.26	1	10	22	5
6	598	4.07	42	35	7	
7	319	3.94	34	35	19	7
8.5	538	3.91	4	7	10	1
8.5	055	3.91	1		9	13
10	229	3.89	27	8	3	1
11	234	3.83	3	6	8	7
12	595	3.81	24	23	7	
13	256	3.72	2	44	18	
15	175	3.62	97	35	3	
15	006	3.62	56	14	8	
15	201	3.62	9	9	3	
17	679	3.60	9	36	17	3
18	138	3.59	61	11		
19	569	3.58	32	8		
20	392	3.57	65	8	2	2
21	168	3.55	16	5	1	
22	701	3.53	22	7	1	
23	059	3.50	25	2	1	
24	049	3.39	23	7	2	
		LOW				

* The Rank Equivalents columns show the distribution of ranks for each job-type.

The job-type with the highest reported job interest is No 283. This group consists of LSMN-CPO concerned primarily with fleet communications and training. As a general point, people working in training roles report high job satisfaction. On the other hand, the group with the lowest reported job interest is No 049. This group consists of PTE-CPL (E) from all three Services. The job description for the group shows that 73 percent of the incumbents spent 12 percent of their time on non-communication tasks. The possible significance of this is discussed later.

Resolution of Job-Type Satisfaction Problems

15. Given that everything possible has been done to ensure frequent job rotation and to minimize out-of-category employment for highly trained specialists, higher level managers might use a posting policy which makes best use of the high satisfaction job-types. This implies two basic options:

a. give highly reported workers a succession of high satisfaction job-types to increase the chances of their retention; or

b. give all workers alternatively high and low satisfaction job-types to ensure that everyone has a "fair go".

16. For either option, posting staff would require:

a. a list of major job-types showing their job satisfaction "status";

b. a list of job-type locations; and

c. the numbers of workers of each rank normally assigned to each job-type.

This information could be represented by numerals and incorporated into a position numbering system.

Correlations Between Job Factors

17. In the Communications Operatives study, the statistical relationships between the factors were generally too weak for any practical purposes. A correlation co-efficient of .42 between job interest and utilization of training shows that the incumbents did not consider the two phenomena synonymously. This means that some incumbents saw no logical inconsistency in reporting, on the one hand, low job interest, and on the other hand, high utilization of training. By comparison, the RAAF Electrical Fitter category had a correlation of .80 for those factors. This indicates that they tended to see job interest and utilization of training as being largely synonymous. In other words, when utilization of training is high, job interest tends to be high. These differences in attitude between Communications Operatives and Electrical Fitters reflect their differing aptitudes, levels of education, training and work experience. The methodological moral to be drawn is that, in the field of job satisfaction, each category must be

considered as a unique unit. Therefore, any allegations containing such statements as: "Job Satisfaction across the three Services is low ---" can be refuted by reference to a sample of categories whose particulars are contained in the occupational data bank.

18. On the subject of employment on non-specialist tasks, the data on the Army Communications Operatives is revealing. A comparison was made between reported utilization of training and the incidence of non-specialist work at the Army unit level. A correlation of .82 shows that as time spent on non-communications tasks rises, reported utilization of training tends to fall. The lowest reported Army unit had incumbents spending 13 percent of their time on non-specialist tasks and 4 percent of their time the administration of stores and equipment.

RE-ENGAGEMENT INTENTIONS

19. Reported re-engagement intentions are of interest to managers for the immediate information supplied, but of equal interest is the possibility of predicting re-engagement levels. In the RAAF Electrical study referred to earlier, there were two useful predictors of re-engagement intentions. These were job interest (.70), utilization of training (.66) and age (.61). The commonsense hypothesis suggested by this is that categories with a long history of low job satisfaction will tend to have low or declining re-engagement rates.

20. One further example, taken from the Army Vehicle Trades, shows that the relationship between utilization of training and re-engagement intentions was .82. This is sufficiently strong as to make Utilization of Training a useful predictor for Vehicle Trades categories.

SUMMARY

21. The analysis of job satisfaction data shows that problem areas can be identified in terms of categories, rank levels and job-type groups. Once the problem areas have been identified, management can be alerted to the need for remedial action.

22. This paper does <u>not</u> suggest that job satisfaction problems should be attacked on a broad front. Given the limitations on resources, management should allocate resources to those categories, ranks or job-type groups are in the most need of help.

23. No attempt has been made to describe cause and effect relationships. However, the job satisfaction indices for job interest and utilization of training may be useful predictors of re-engagement intentions. However, this possibility must be considered category by category with no immediate promise of the development of universal laws of job satisfaction.

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JOB DIFFICULTY AND APTITUDE REQUIREMENTS MATCHING THE MAN AND HIS JOB

By Dr R.E. Christal

1. We presently are in the latter stages of a large study in which we are attempting to evaluate aptitude requirements for Air Force occupations. However, since some managers seem not to recognize the benefits received from selection and classification testing, I thought I would spend a little time addressing this issue first. Evidently, we have done an inadequate job of merchandising our test products. I have heard of some managers who went so far as to suggest that we do away with testing altogether. As I review the situation, I find that we have defended aptitude tests on three grounds: (1) their ability to predict performance on the job; (2) their ability to predict attrition in training; and (3) their ability to predict course grades. Let's look at these factors, one at a time.

2. First, let's consider job performance. Now let's be honest about it. We really don't have overpowering evidence that our tests predict job performance, and informed managers and operators know that we don't. Many of these individuals are of the opinion that the key to productivity is not individual differences in aptitude, but good management. Experience teaches them that most of the personnel they deal with on a day-by-day basis could get the job done if they simply applied themselves. The individual differences they observe are mostly motivational, or else are not job related. Of course, these managers are at least partially right. What they fail to understand is that this lack of variance is, to a large extent, the product of testing and training. If managers in an electronics maintenance occupation were to receive a random sample of untrained personnel out of the general population and attempted to generate the required skills on the job, I can assure you that they would quickly become acutely aware of individual differences in aptitude. However, this would not be an efficient way to run a military service. We use tests to select and classify individuals into occupations such that each person has the capacity to acquire the necessary skills for acceptable job performance. The training program, in turn, is geared to provide each trainee with these required skills. If the process is efficient, then there is no reason why tests should have high validities for performance on the job. This is especially true for occupations requiring simple application of fully-developed skills.

3. The second way we have defended our tests is by showing how well they predict attrition in training. In the Air Force, a washout in pilot training costs the service millions of dollars, and the claim is made that millions of dollars of additional costs are avoided each year by using tests to screen out applicants likely to fail in training. On the surface, this sounds like a strong case for tests. It is known that within any training class, individuals with low aptitude scores wash out at a much lower rate than individuals with high scores. It is also true that washouts are costly. However, it is not easy to demonstrate that tests save money by reducing washout rates. Some data extracted from the Army Air Forces Aviation Psychology Program Research Report No 2 (Dubois),

Class	N	Aptitude Cutoff	Percent Eliminees
44C	12,232	3	15.5
44F	9,371	3	12.0
44I	6,466	4	19.6
45A	6,525	4	21.0
45D	1,384	4	21.5
45G	664	6	27.4

Table 1. Attrition Rates and Aptitude Input for Every Third Pilot Training Class (44C Thru 45G)*

4. Table 1 reflects pass/fail data for every third class from 44C through 45G. In classes 44C and 44F, the cutting score on the aptitude score for entry was Stanine 3, and the average attrition rate was 13.9%. In classes 44I, 45A, and 45D, the cutoff was raised to Stanine 4. However, instead of going down, the attrition rate increased to 20.4%. Finally, in class 45G, the cutting point was raised to Stanine 6, yet the attrition rate went up again - clear up to 27.4%. In view of these data, one might conclude that attrition in pilot training would be minimized if those cases having the least aptitude were entered into training. Of course, this is not true. The fact is that attrition rates were controlled by administrative actions, and were not dependent on the quality of the input. The number of pilot graduates was determined in large part by the number of cockpits to be filled. The data shown in Table 1 reflect actions taken toward the end of the war as the number of trained pilots became abundant and aircraft production was reduced. We have good reason for believing that the quality of graduates from these classes varied, but we cannot demonstrate that the use of tests saved money by reducing attrition rates. We would have even a more difficult time demonstrating the influence of tests on attrition rates in enlisted courses. The number of graduates from such courses is ordinarily programmed months in advance to meet operational requirements, and fluctuations in input talent produce only minor fluctuations in attrition rates. During periods of low quality input, it is not uncommon to increase wash-backs and remedial training to maintain production standards.

5. A third way we have attempted to show the value of aptitude tests is in terms of their ability to predict final course grades. The fact that aptitude tests do predict course grades is irrefutable. There is ample evidence both in military technical reports and also in the civilian literature. However, many managers are not impressed by the fact that tests predict school grades. Increases in school grades cannot be easily translated into precise statements of benefits.

6. In the future, I feel we should defend tests in terms of their ability to predict speed of skill acquisition and costs of skill maintenance. The US military services spend

literally billions of dollars each year supporting the development and maintenance of skills. The more obvious expenditures are associated with formal residence and on-the-job training courses, but this is just the top of the iceberg. For example, the Air Force spends hundreds of millions of dollars each year just to maintain pilot and navigator skills. Even more costly is the time individuals in all services spend in learning to perform new tasks as they are encountered on a day-by-day and assignment-by-assignment basis. To the extent that aptitude scores predict the time required for individuals to acquire and maintain skills, they can be used to reduce costs and optimally distribute talent to jobs. There is nothing unique or new about the concept of aptitude scores predicting learning rate. For example, in 1963, John B. Carroll recommended that aptitude be defined as learning rate (Carroll, 1963). The first intelligence test developed by Alfred Binet, back in 1904, was designed to measure differences in the level of skills acquired by individuals during a constant time interval (chronological age). These scores were later normed and converted into a score "mental age." A ratio of the mental age to chronological age was computed and came to be called the Intelligence Quotient (IQ). Regardless of the problems associated with the development and utilization of IQ scores, they have been used for years as rough indicators of individual learning rates. In the academic world, many tests are called learning abilities measures, and have been used for decades by teachers to place pupils into homogeneous groups so as to minimize variance in learning rates within groups. Tests have been shown to be valid predictors of school grades, both in the academic world of the civilian sector and in all military services, and school grades can be viewed as the amount of content mastered by students when learning time is held constant. Aptitude tests also predict proficiency test scores in the services, which are rough measures of the amount of content mastered by individuals at various career points. In Project UTILITY (Vineberg and Taylor, 1972), which was conducted for the US Army by the Human Resources Research Organization in the late 1960s, AFQT scores were shown to be related to the rate of skill acquisition in several occupational areas. Pilot training programs are generally locked-step. For this reason, I have been unable to locate data demonstrating that aptitude scores predict speed of skill acquisition. However, pilot aptitude tests do predict within-class elimination for flying deficiency, and individuals in the flying research area assure me that slowness in acquiring skills is the primary cause for such elimination. This observation needs to be confirmed by carefully controlled research.

7. While the evidence that aptitude scores predict learning rate is substantial, most of it is indirect. Controlled studies are needed before units of aptitude can be precisely related to units of learning per unit time.

8. There is even less direct evidence concerning the relationship of level aptitude and the time required for skill maintenance. However, it would seem rather safe to assume that, if aptitude scores predict time for acquisition of new skills, they would also predict the time required for reacquisition of decayed skills. A question more open to doubt is whether aptitude scores will predict rate of skill decay. Underwood (1954) published one summary paper in which he concludes that, when associative strength is held constant, there are no differences in forgetting rates as a function of aptitude during the first 24 hours. However, this study dealt with laborative studies of associative learning and short decay periods. The military services should be able to provide more definitive answers concerning individual differences in forgetting rate as a function of aptitude.

9. One very revealing study was reported by the Naval Personnel and Training Research Laboratory in 1970 (Johnson, 1970) which provided data relating to the skill decay question. The study was based on material being taught in the first phase of the avionics fundamentals course. Proficiency was measured by means of the criterion referenced tests that had been used to validate the programmed instructional material used in this phase. Measures were obtained on a pre-test, on an immediate post-test, and at intervals of 1 day, 7 days, 28 days, and 96 days following the original learning. It was found that in spite of a fairly high level of mastery on the immediate post-tests and a considerable amount of review, much of the material learned during the first phase of the course was forgotten by the end of the course. The differences between individual students were large on the pre-test, were quite small on the immediate post-test, and increased gradually over the remaining post-tests until, by the end of the course, they were almost as large as they were on the pre-test. Although this study was based on only a fairly small N, it did provide a set of relatively unique data. The experiment began with 141 students. Seven were dropped for administrative reasons; eight failed because of slow progress; 21 washed back because of slow progress; and 17 were moved ahead because of fast progress. Thus, only 85 cases were left in the final sample, and these cases were fairly homogeneous in terms of learning rate. In spite of this homogenization process, data in the study can be reanalyzed to reflect differential decay rates as a function of aptitude. As can be seen in Table 2, aptitude scores account for 24% of the final test score variance, with original pool test scores held constant (partial multiple R^2). Although one might argue that associative strength was not held constant, from a practical standpoint it can be stated that individuals showed differential decay rates in criterion referenced test scores as a function of their aptitude levels.

Predictors	Validities for Final Post-Test	
	R^2	R
Immediate Post-Test	.185	.430
Aptitude Tests Alone	.312	.559
Immediate Post-Test Plus Aptitude	.382	.618
Unique Contribution of Aptitude Tests	.197	.444
Aptitude Tests with Immediate Post-Test Scores Held Constant (Partial R^2 and R)	.242	.492

Table 2. Retention of Electronics Fundamentals as a Function of Aptitude

10. Aptitude or ability tests are used by most military services for the selection and classification of personnel. In the US Air Force, we have established minimum score standards for entry into the service and also minimum score standards for entry into each occupation. The person-job-match system, which I will discuss later, is designed to fill all vacancies with individuals who meet minimum score requirements. Beyond this, it is designed to offer the most demanding occupational assignments to the most talented Air Force applicants. A goal is optimum distribution of available talent. Before proceeding, I would like to stress the importance of efficient assignment of talent. Very few people appreciate the large variance in learning requirements among occupations. In the Air Force, we have enlisted occupations for which our slowest learners (those with the lowest aptitude) can prepare in six weeks. We have other occupations for which our fastest learners cannot be fully trained in a year. They are still considered to be neophytes when they reach their first job. At the same time, there are large differences in the learning abilities among individuals. Many articles in the literature report ratios of 1 to 3, 1 to 7, 1 to 9, and even 1 to 60 in terms of ranges of learning times of individuals to master various types of learning tasks. A recent reanalysis of data from project utility brings this point home. Approximately 400 repairmen were asked to perform a standardized list of critical maintenance tasks under observation. They were scored by trained observers on the number of tasks performed correctly. Although the study was based upon a cross-section sample, it was possible to draw curves representing the percent of correct actions taken by workers as a function of their aptitude levels and months of job experience. The results were striking. Fresh school graduates at the 75th centile on the Mechanical Aptitude Index performed 60 percent of the tasks correctly, while those at the 25th centile performed only 30 percent of the tasks correctly. Thus, those at the higher aptitude level performed twice as many tasks properly as those at the lower level. Of greater significance was the finding that it took a full <u>two years</u> of job experience before those at the lower aptitude level were performing equal to the <u>beginning</u> level for those at the highest aptitude level. The fact that these curves were drawn from cross-sectional data make the conclusions conservative, since a

significant number of low performers were separated from service during the first two years.

11. Considering the wide range of "learning loads" associated with occupations and the wide range of learning rates among individuals, it becomes clear that military services should strive to assign their fast learners to the more difficult occupations. There is good evidence that the learning rates of individuals is measured fairly well by aptitude or ability tests. What is missing in the equation is a dependable measure of the learning loads associated with occupations. In the US Air Force, we have established aptitude score minimums for entry into each occupation, but these values were set by judgment. They were not based on a systematic analysis of job content. Before the occupation survey and CODAP analysis procedures were implemented, there simply was not sufficient information concerning jobs to evaluate learning loads. However, HQ USAF recognized several years ago that the established aptitude minimums needed to be validated, and they asked us to use our occupational data bank for accomplishing this goal.

12. At the onset, we recognized that it was not possible to defend any aptitude cutting score as a minimum below which individuals could not be trained successfully to perform in an occupation. If an entry-level course were lengthened, then individuals with less aptitude could master its content. Also, introduction of job performance aids might enable lower aptitude personnel to perform successfully in an occupation. For these and many other reasons, we felt that we would have difficulty in defending absolute aptitude minimums. It should be recognized that aptitude scores have no absolute meaning. They simply represent an individual's standing relative to other individuals in some standardization population. We felt that on the job side we would be unable to measure learning requirements in an absolute sense, but that we might be able to measure the learning load for any occupation relative to other occupations. If one knows the relative learning rates for a sample of individuals and the relative learning requirements for a set of jobs, this is sufficient information for making optimal classification assignments.

13. Fortunately, we had been collecting task difficulty ratings from supervisors when we conducted our occupational surveys. Furthermore, we had defined difficulty in terms of "relative learning difficulty." Thus, we already had on hand sufficient information to evaluate the relative learning requirements for tasks within each occupation, and we could use the CODAP system to compute the relative learning requirements for tasks within each occupation. What we could not do was to determine the difficulty of tasks and jobs in any one occupation with those in other occupations. We had to find some method for rescaling tasks from all occupations so that they could be compared directly. The method by which this

was accomplished is too complex to describe in this meeting. Let me simply state that it involved teams of contractor personnel who studied nearly 10,000 work tasks in the operational environment. Each of these tasks was evaluated by up to 14 independent observers using a 25-task benchmark scale. Ratings were accepted only if there was high inter-rater agreement among raters. Information concerning these 10,000 tasks were used to rescale the remaining tasks in each occupation and, once we had estimates of the learning difficulties of all Air Force tasks on the same scale, we were in a position to compute the relative learning loads for all jobs in those specialties on which we had job survey data.

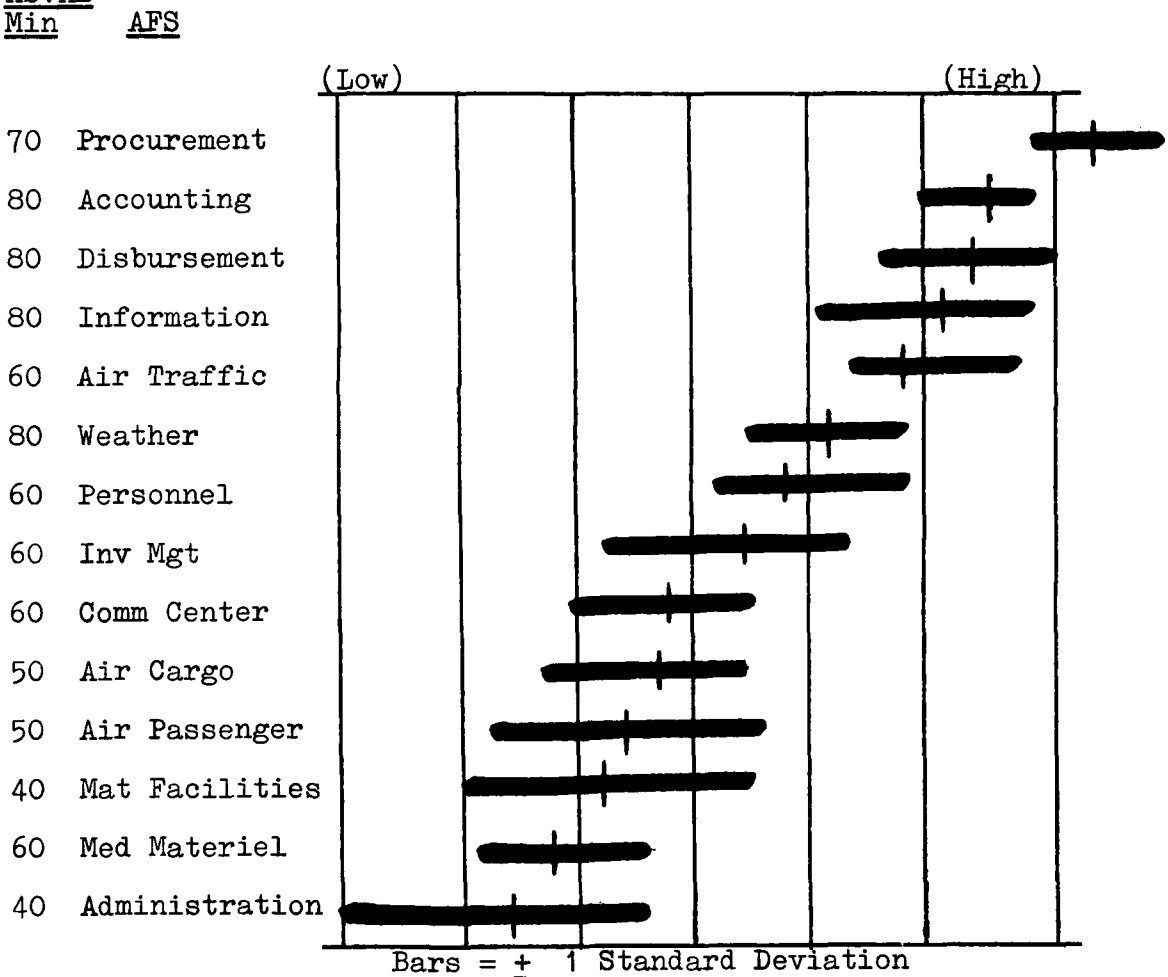

Table 3. Relative Difficulty Levels for 1st Termer Jobs

14. I'm not in a position to present final data coming out of this study since they are being staffed. However, I will show you tables from an earlier probe study which illustrate the types of outputs which can be obtained using the CODAP system. Table 3 presents information concerning the present aptitude requirements for 14 occupations along with the relative difficulty levels of first-term jobs in those occupations as determined in the probe study. The

vertical dash in the middle of the bars represent the mean difficulty levels of the first-term jobs. A bar covers plus one standard deviation; thus it represents the middle 68 percent of jobs in a specialty. A short bar indicates an occupation in which jobs are homogeneous in terms of difficulty. A long bar indicates a wide variance. The jobs are ordered in terms of relative difficulty. It appears from these data that current aptitude requirements are out of alignment. We have been selecting Procurement Specialists at the 70th centile; yet the learning load (difficulty level) associated with this occupation is higher than for jobs in Accounting, Disbursement, Information and Weather occupations, all of which are selected at the 80th centile level. Medical Materiel has a cutting score at the 60th centile, but appears to contain easier jobs than are found in Air Passenger and Air Cargo, both of which are selected at the 40th centile.

RELATIVE APTITUDE REQUIREMENT LEVEL	General Accounting (A80)	Disbursement (A80)	Inventory Management (A60 or G60)	Air Passenger (A50)	Materiel Facilities (G40)
5.0					
	Accts Cont				
4.5					
		Travel Acctg	NORs Control		
	Comm Svcs	Military Pay			
			Auth & Allow	Recds & Repts	
4.0		Pay & Coll			
			Item Research		
3.5			Document Cont		Bench Stock
				Passenger Traffic Cont	Supply
					Warehouse
3.0				Aircraft Services	
2.5					

Table 4. Relative Aptitude Requirements for Selected Job Types

15. Now, let us look at variations in job types. Table 4 shows selected job types from five of the occupations in Table 3. Notice that the records and reports job type in the Air Passenger Specialty (selected at the 50th centile) is more difficult than the Commercial Services job type in the Disbursement Specialty (selected at the 80th centile). At the same time, the Aircraft Services job type in the Air Passenger Specialty is considerably less difficult than job types in the Materiel Facilities Specialty (selected at the

40th centile). Data such as those shown in Table 4 can be used in restructuring occupations. In case of talent shortages, some of the low difficulty job types could be organized into new management categories to be filled by low-talented personnel. Table 5 displays the most time consuming tasks in the Aircraft Services job type.

D-TSK	Duty/Task Title	Cumulative sum of average percent time spent by all members	Average percent time spent by all members	Average percent time spent by members performing	Percent of members performing
F 20	Install Fleet Service Equipment	87.42	7.62	6.66	6.66
F 17	Deliver In-flight Meals to Aircraft	77.36	7.38	5.71	12.37
G 13	Load Fleet Service Supplies in Aircraft	77.99	7.31	5.70	18.08
F 18	Fill Fresh Water Tanks and Containers	81.76	6.66	5.45	23.53
F 19	Flush and Fill Lavatories	76.73	6.80	5.22	28.75
G 11	Inventory Fleet Service Equipment Aboard Acft	76.10	6.54	4.97	33.72
C 26	Inspect Fleet Service Equip Installed in Acft	62.26	6.66	4.15	37.87
K 28	Load or Unload Passenger Baggage	16.98	20.59	3.50	41.36
F 6	Clean Passenger Aircraft	57.86	6.02	3.48	44.85
G 30	Replenish Passenger Service Kits	37.11	7.89	2.93	47.77
H 5	Clean Work Areas	40.88	7.07	2.89	50.67
F 25	Prepare Fleet Service Records or Reports	53.46	5.14	2.75	53.41
B 7	Direct Fleet Service Functions	44.65	5.76	2.57	55.99
F 21	Maintain Fleet Service Records Files	46.54	4.67	2.17	58.16
K 15	Deliver Passenger Baggage	14.47	14.64	2.12	60.27
G 10	Install or Stow Fittings & Tiedowns	28.30	6.91	1.95	62.23
B 45	Supervise Installations of Fleet Svc Equip in Acft	38.36	4.88	1.87	64.10
F 5	Clean Cargo Compartments	36.48	4.52	1.65	65.75
F 14	Co-ordinate Fleet & Maint Operations w/Load Masters or Technical Representatives	28.93	5.43	1.57	67.32
A 11	Establish Local Procedures for Fleet Service	24.53	6.09	1.49	63.81

Table 5. Aircraft Services Job Cluster

TASKS (N - 781)	X
Perform Fault Isolation of 12A96811 Pentration Aids Test Station	24.3
Perform Fault Isolation of AN/AUM-11 Head-Up Display Test Sets	20.5
Perform Acceptance Inspections of Installed Test Stations or Test Sets	17.8
Evaluate Equipment Change or TO Change Proposals	17.4
Perform Alignments or Adjustments of CENPAC Programmer Panels	16.9
Purge or Change Cryogenic Converters with Helium and Nitrogen	16.2
Remove or Replace Travelling Wave Tubes	15.5
Remove or Replace Transistors	14.6
Remove or Replace Relays	13.7
Remove or Install Test Stations or Test Sets	12.9
Remove or Replace Electrical Motors	12.0
Remove or Replace Fuses	6.5

$\bar{X}$ ATDPUT = 14.7, $SD_{\bar{X}}$ = 1.48

Table 6. Predicted Task Difficulty Avionics Areas

TASKS (N + 357)	X
Troubleshoot Intrusion Alarm Systems and Identify Malfunctions	16.8
Determine Power Circuit and Control Requirements for AC Equipment	14.9
Adjust AC Controls or Sensors	14.0
Remove or Replace Motor Starters or Controls	13.5
Install and Connect Interior Power Controls	13.0
Install Dining Hall Appliances or Fixtures	12.5
Repair Internal Wiring or Connections	12.2
Troubleshoot Lighting Systems	11.6
Splice Wiring or Cables	11.0
Inspect and Service Emergency Battery Lighting Units	10.5
Remove or Replace Fuses	8.5
Remove or Replace Extension Cords, Wiring, or Plugs	5.6

$\bar{X}$ ATDPUT = 10.3, $SD_{\bar{X}}$ = 1.48

Table 7. Predicted Task Difficulty Electrician

16. Tables 6 and 7 display selected tasks from two specialties for which individuals are selected using the Electronics Aptitude Index. The first is the Avionics Repairman Specialty, and the second is the Electrician Speciality. Notice that both specialties contain some easy tasks. However, the "average task difficulty of tasks performed per unit time" (ATDPUT) by Avionics Specialists is more than two standard deviations more difficult than those

performed by Electricians. In the full CODAP display, 781 tasks are listed for the Avionics Specialty. Review of rescaled tasks helps one form a context for interpreting the final study results. We soon will have rescaled difficulty indexes for more than 100,000 tasks, and we will have computed rescaled difficulty indexes for several hundred thousand Air Force jobs. Studies of this magnitude would be impossible without the job survey and CODAP analysis system.

17. I've talked about the value of aptitude tests, and attempted to show that their primary utility lies in their ability to predict individual rates of skill acquisition. I've described a technology using the occupational survey data and the CODAP analysis system which enables us to measure the relative difficulty levels of tasks, jobs, job types, and occupations. Now, let's talk a little about how this information can be used. First, it can be used to bring aptitude requirements for entry into various occupations into alignment with job difficulties. In the past, aptitude requirements have been established by judgment, and the present study indicates that in some instances they are not in alignment with job demands. Second, they can be used to build contingency plans for manning the force in the face of talent shortages. Among the options are: (a) to reduce requirements for the lowest difficulty occupations; (b) to make new management categories out of low-level job types and have them manned with lower aptitude personnel; and (c) to engineer new jobs from simple tasks and have them performed by lower aptitude personnel. Third, the difficult tasks can be studied for remedial actions. We are planning to identify difficult tasks for which job performance aids should be produced.

18. A primary application of the job difficulty information by the US Air Force is in its job offer system. This new computerized system weighs a number of factors in helping the Air Force to decide which jobs to offer each applicant who wishes to come into the Air Force. It maximizes the probability of making fill. If we are falling behind in filling a particular occupation, the system automatically adjusts itself to offer that occupation to more qualified applicants. It gives weight to the applicant's job preferences. It services management goal's such as the equitable distribution of minority groups across occupations. It forecasts the near-term quality of the applicant pool, so that it will not offer jobs to an individual when better qualified applicants are expected in the near future. It gives weight to the predicted success of each individual in various training courses. In the near future, the system will predict the probability of attrition and tend to offer high-cost training only to those who are likely to survive the first enlistment. We are evaluating the strength and stamina requirements for occupations, so that the system will offer physically demanding jobs only to those individuals who have the strength and

stamina to perform them. All of these factors are important. However, a core feature of the person-job-match algorithm is that it offers the most difficult jobs to the most talented applicants. Until recently, we knew the talent level of each applicant, but we did not have accurate information about the difficulty of jobs. Now, thanks to our occupational data bank and CODAP analysis system, we have good data on the relative difficulty levels of nearly all Air Force jobs.

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TRAINING RESEARCH IN THE UNITED STATES MILITARY ESTABLISHMENT

By Dr R.E. Christal

1. You have asked me to give a brief overview of training research in the United States military establishment. This is a large order for one not in the training business. You must understand that all I can do is to present my own perspective, which is like one of the blind men describing the elephant.

2. About the only training research conducted in my own Division has been associated with the establishment of training requirements. Although the CODAP system has made a major contribution to determining training requirements, there is a lot more to be done before we become really sophisticated. This is an important research area because you can spend millions of dollars in training on the wrong things.

3. The Air Force and Navy both have supported research on fully proceduralized job performance aids. The Air Force has built aids for all major tasks for an entire specialty. Tests indicated that individuals with very little formalized training could perform their jobs adequately using these aids. However, there were negative reactions to this program. Many individuals do not like to have every step of their job prescribed. They want an understanding of what they are doing, and why they are doing it. Another problem is that it is very expensive to produce aids for all tasks in a job, and sometimes the tasks change rapidly as components are replaced. This makes it expensive to keep aids current. It looks as though, in the future, we may produce aids only for those tasks which are difficult and critical. Individuals can use the aids when they feel a need to do so. I should add that many useful by-products have come from our performance aids research. We learned how to produce good guides in an efficient manner. Some of the technology is being used to prepare materials included in maintenance manuals.

4. The US Navy still has a health program in the performance aids area. Their approach is to eliminate some training on entry-level courses and to substitute performance aids for use by individuals on the job.

5. The Air Force has conducted some research on Computer Assisted Instruction (CAI) and considerable research on Computer Managed Instruction (CMI). In CAI, the computer stores and provides instructional materials to students individually at computer terminals, but this may be mixed with group instruction on occasions. On the other hand, in CMI, the instructional materials and the tests are provided away from the computer terminals. The computer is used to score the test, to grade the students, and to make certain prescriptions about follow-up materials. There is a third stream of research concerned with individualized instruction which is self-paced and has no computer support. There are some tentative conclusions to be drawn about these modes of instruction. From about 30 studies that I reviewed, it appears that CAI and CMI save about 30

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percent of student time in meeting standards. Many of the studies have small samples, but if you average across them, you find a 30 percent saving. There seems to be a slight increase, not a decrease, in student attrition. There is a consensus that student evaluation is vastly improved. In terms of student attitudes, nearly all studies showed that the students liked it better than they liked group instruction in the lock-step courses. In regard to the instructor's attitudes, they would rather be teaching in the classroom. I have some first-hand experience of the Air Force's attempt to implement CMI at Lowry Air Force Base. The biggest problem was with the instructors who were brought up with the old system. It is difficult for those who have had the pleasure of teaching to become only advisors when asked questions. This is not so rewarding to the instructors. If you are going to implement this technology, you may need a new breed of instructors. The question of cost benefits is still being debated. There is a lot of information on costs but not much quantified information on benefits. Also, there have been no useful comparisons between CAI, CMI and individualized instruction without computers.

6. In the Air Force, we have had experiments in four course areas using CMI. There are about 3,000 students a year going through these courses. The system has 50 student terminals, 10 management terminals, and one central computer. The research is winding down now and the next question is whether to implement the technology on a wide scale.

7. Without question, the biggest training research thrust in the United States is associated with simulators. This work involves many agencies with psychologists and engineers working together. The US Army has been very active with first-generation engagement simulation systems (REALTRAIN). In one report, it was claimed that individuals being trained in this system obtained 26 percent more distribution of opposing weapons while sustaining 49 percent fewer casualties compared with those trained by conventional systems. Also, the Army is working on training devices associated with artillery, air defense, engineering, infantry, armor and anti-armor. There are battle simulation systems, marksmanship systems, infantry remote target systems, and laser devices for gunnery.

8. The Navy has a large research program in simulation technology. This includes utilization of fibre optics, holograph and laser devices. Other activities involve simulated avionic maintenance trainers, a Navy aircraft ordnance simulator, an aviation weapon system simulator, weapons delivery simulation, an automated air intercept control trainer, a synthetic fire fighter simulator, a submarine advanced reactive tactical training system, an advanced visual-near visual electro optic sensor simulator, a Class A electronic equipment maintenance simulator, and a Navy war gaming system. Also, there is a prototype combat system trainer designed for people who work on guided missile frigates. This is used to train people who are in port for long periods and to enhance their capabilities with target detection equipment. Other programs concern the Mark 86 Team Trainer, the Terrier Operator Trainer, the L Mark III Operational Team Trainer, the Fire Control-Search Trainer, and the Mark 92 Operational Trainer.

9. The Air Force has done a little work on maintenance simulators. They find that bringing equipment into the classroom is often expensive. Also, it is not very practicable for training because you cannot generate malfunctions very easily. There is a firm belief that you can build simulators which are, in many instances, more practicable for training than the real equipment. Of course, most of the Air Force research has to do with simulation of things associated with flying. We have a lot of basic research in the visual area for fighter attack simulation. For example, we have engineers and psychologists working on higher resolution multi-channel color projectors for projecting high resolution target images; on methods to enlarge photographic images; and on methods to decrease distortion in photographic windows. Another research area concerns computer generated imagery. At Williams Air Force Base, they developed an inventory of anything you might see from an airplane over Arizona. The aim was to generate all the imagery on wraparound TV screens, using digital information from computers. At first everything was square but now they have cleared up the edges and improved the imagery. They have conducted research to determine the extent to which motion is essential in training. This is very important research because if you can do without motion, you can avoid much of the expense of large simulators. Present research streams include studies related to air-to-ground delivery systems, air-to-air combat simulation, air refueling operation simulation, take-off and landing trainers, and tactics training. The wave of the future appears to be associated with engagement simulation.

10. To summarize, the big training research push is associated with the use of simulation. Simulation training is often cheaper than training on real live equipment. It is safer, and you can train on some things that are dangerous to train on in live equipment. The biggest advantage and benefits of simulation may not be in saving money, but in the fact that it actually generates better combat skills. That is a primary goal of training. Cetainly, you can evaluate performance a lot better when people are operating a simulator. The big question being addressed now is the transfer of training. For some operations, it has been demonstrated that people trained in simulators perform better than those trained in operational aircraft.

11. In the past, there has been a lot of similarity in the research being done across the services. As a result, there is some "get-your-act-together" pressure being applied. In the last couple of years, the services have worked closer together to ensure that there is little duplication of effort. There is good transfer of information from one service to another. There are committees which try to identify the research gaps. The inter-service co-operation in trying to solve common problems is a very healthy movement.

MANPOWER CONTINGENCY PLANS

Wing Commander J.W.K. Fugill (Ret)

INTRODUCTION

1. Contingency plans are advance preparations for dealing with emergencies not considered in the regular planning process.

2. Philosophy students see contingency plans as hypothetical syllogisms which take the form:

If X, they Y

Unfortunately for military planners, the beauty of this simple X and Y relationship is seldom appreciated as they come face-to-face with the realities of ill-defined assumptions, unknown factors, and insufficient and unreliable data about people's behaviour.

3. The pre-conditions for successful manpower contingency planning include:

a. the identification of realistic problems for which solutions are imperative,

b. the willingness to persevere with long-term planning as opposed to "quick and dirty" solutions,

c. the existence of a comprehensive data bank about people's work behaviour, and

d. a set of principles or guidelines (models).

AIM

4. The aims of this paper are to:

a. pose several practical manpower problems which may arise in the event of rapid force expansion, and

b. demonstrate how the CODAP job-type diagram can be used to prepare contingency plans to meet such an event.

JOB-TYPE DIAGRAMS

5. The preparation of the manpower contingency plans discussed in this paper requires few resources additional to those normally used by the occupational analysis cells. In addition to the basic job descriptions and summaries of variables, a Group Membership printout is called for to assist in the drawing of a branch diagram. Each circle in the diagram represents a work group. Using empirically determined guidelines proposed by Archer in 1966, decisions are made as to which groups represent significantly different job-types. The individuals within each job-type group

perform the same tasks and tend to spend about the same time in performing those tasks. The homogeneity of such groups offer management safe options in the development of manpower contingency plans.

6. Apart from the stated aims of this paper, this paper, this presentation seeks to illustrate the versatility of the job-type diagram, which up to now, has had limited practical use.

THE 'LEAST HARM' CONCEPT

7. In the face of a major military threat to Australia, could the Australian Defence Force fill recruitment quotas without a lowering of performance standards? If recruits are not available with the prescribed mental and physical attributes, what reductions in standards could be recommended which would do the least conceivable harm?

8. Job requirements standards were established, in the first instance, as a matter of judgement, largely subjective. Adjustments made from time to time were based on recommendations by commanders and trainers who were concerned with minimizing training failure rates, and reducing errors in operational situations. Obviously, an proposal to lower job requirement standards will receive reluctant acceptance by field commanders and trainers alike. However, in an emergency, the extent to which this reluctance is rationally or logically based will be largely academic. *In seeking to recommend* actions which will do the least conceivable harm, thought must be given to the likely impact that such actions would have on job performance, career development, posting flexibility, and job satisfaction.

APTITUDE

9. If there is a diminishing supply of high aptitude recruits, what actions could be taken to fill enlistment quotas with least jeopardy to operational efficiency?

Low Difficulty Job-Types

10. The first action is to identify significant job-types into which lesser talented people could be placed with least harm. For each job-type within a category, the average task-difficulty level is calculated (the task-difficulty ratings are supplied by work supervisors). The job-types are then arranged in order from the highest difficulty to the lowest difficulty. The job-type with the lowest difficulty becomes the first candidate for aptitude reduction.

11. As a real-life example, the job-type diagram for Army Vehicle Trades will be used. There are nineteen distinct job-types. The job-type of lowest difficulty is Stores Accounting and Handling. There is a small element of minor adjustments and repairs which could be catered for by on-the-job training. The use of lower aptitude people in this group would release other members for more demanding work.

ARMY VEHICLE TRADES

GROUP	JOB-TYPE	DIFFICULTY	No.
024	Instructors	4.5	15
128	Workshop Inspection	4.1	6
*			*
*			*
*			*
*			*
029	Training Administration	3.8	23
082	Minor Unit Repairs	3.6	6
114	Personnel Administration	3.5	34
043	Stores Handling and Accounts - Minor Repairs	3.2	21

12. In practical terms, aptitude requirements can be lowered on an actuarial basis - for each successive concession, the size of the manpower pool becomes progressively greater. As this process releases higher talented people for re-assignment to more difficult jobs, there is a bonus to be gained in the enhancement of job satisfaction.

Job Performance Aids (JPAs)

13. A second possible action requires the identification of sets of tasks which could be performed by low aptitude people given appropriate verbal and pictorial job performance aids. The criteria for the adoption of JPAs are:

a. the "start" and "end" of the task are defined clearly,

b. task procedures have only minor variations,

c. decision options are clear, and

d. the instructions can be proceduralized through simplified expression, pictures and diagrams.

14. The advantages of JPAs are the reductions in training time and performance time once habit patterns have been established. The early productivity engendered by the use of JPAs will enhance the

job satisfaction of those individuals whose ability is the most limited. On the negative side, job incumbents who have been trained to rely on JPAs may not perform satisfactorily on non-routine tasks. They will not become part of the senior supervisory pool whose members can solve difficult and unique problems.

EDUCATION

15. If there is a diminishing supply of educationally qualified recruits, what actions could be taken to fill enlistment quotas with least jeopardy to operational efficiency?

Low Education Job-Types

16. This method requires identification of job-types for which normal education requirements may be waived with least detriment to work performance. Work supervisors would be asked to provide ratings on the levels of reading comprehension or mathematics inherent in each task. Job-types requiring least reading and/or mathematical ability would be the first candidates for induction of the lesser education. This action would release the better educated individuals for higher knowledge-oriented jobs.

Creation of New Job-Types

17. A second approach is to identify easy tasks which might be separated out of existing jobs and engineered into new jobs for lesser qualified people. The criteria for establishing new jobs is that they be meaningful, full-time, and not dispersed across widely separated locations. An example of a re-engineered job would be the aircraft ground handler. The ground handling tasks would be taken over by this individual, thus releasing aircraft tradesmen for more difficult work. Training courses for handlers would have limited objectives and, therefore, training time would be minimal. As a caveat to this proposal, it is noteworthy that in 1973 RAAF Engine Fitters and Airframe Fitters in their first year of work spent about 11 percent of their time on aircraft handling and cleaning.

Reading Comprehension Levels

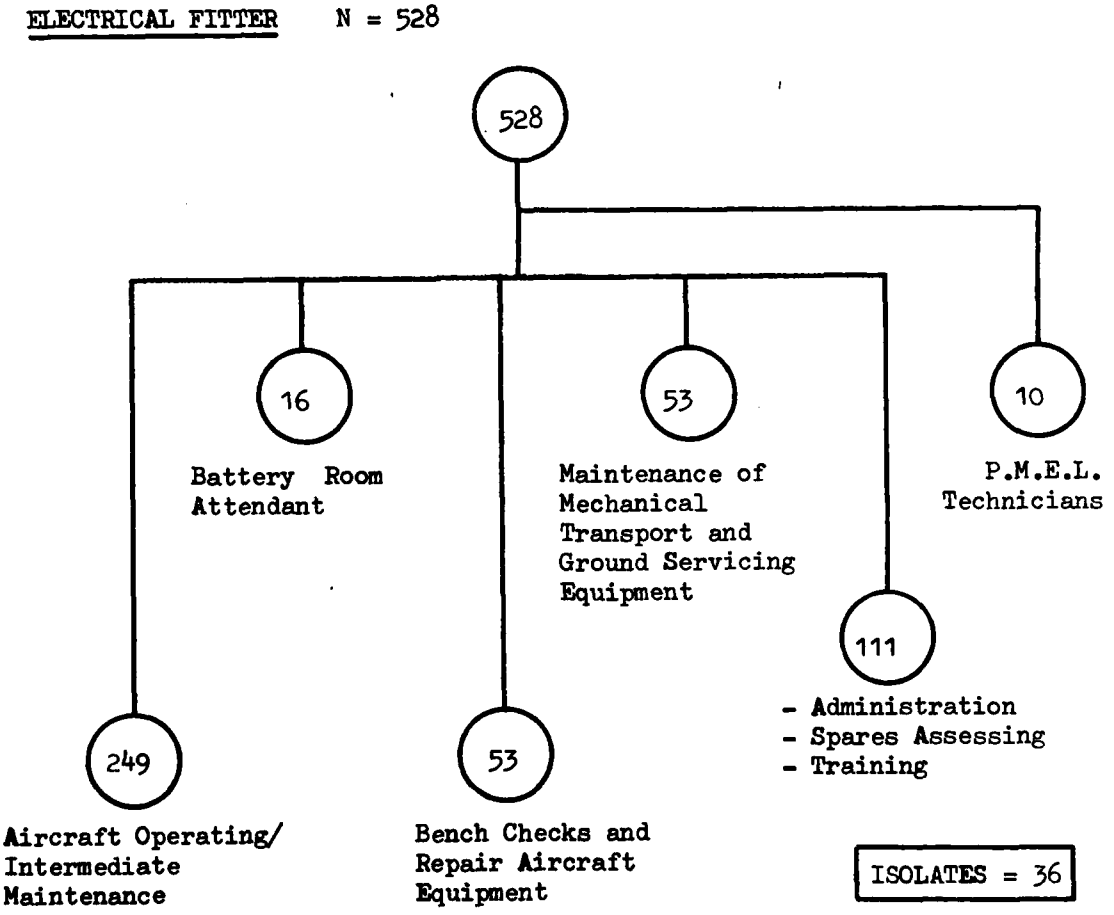
18. A third possibility is a general review of the reading comprehension levels of technical and administrative orders. A study reported from Nellis Air Force Base in 1971 showed that some aircraft maintenance documents required reading ability at second year university level. However, an especially pertinent finding was that the incidence of non-compliance to maintenance orders correlated highly with the reading levels of airmen committing offences. Airmen of low reading ability were much more prone to errors than airmen of high reading ability. Since out Services are operating equipment of comparable complexity to the US Services, a review of reading materials might be incorporated into any forward-looking plans.

TRAINING

19. If pressure is applied for a general reduction in training time, what actions could be taken to meet such a demand with least jeopardy to operational efficiency?

Job-Type Training

20. The underlying concept is work-oriented job-type training for some as opposed to broad category training for all. Obvious examples are aircraft handlers, battery shop processors and storemen in technical categories. If real savings can be made with job-type training, then it can be argued that traditional category training could continue without reductions in time. The job-type training concept is illustrated by reference to the RAAF Electrical Fitter diagram. The Battery Shop group perform tasks which require considerable less training for satisfactory performance.



The Battery Shop attendants represent three percent of the category - about 27 people. If the category had to expand five-fold, then the job-type training goal is 135. With the job-type job description, an estimate can be made of the number of training weeks required to fulfill that goal. For the Ground Servicing Equipment group, main-

tenance personnel could be recruited directly from civilian life because the work required is similar to that performed by automotive electricians.

Category Training Reductions

21. Having suggested the first sequential action to be taken, the second possibility is to make reductions in category training. Occupational survey information can identify areas of irrelevant training or areas of lesser relevance. Task can be rank-ordered on the basis of relevance. The tasks of least relevance can be omitted first, and as pressure for reductions in training time increases, more tasks can be eliminated progressively. Captain Gorman's paper on the Electronics Principles Inventory (EPI) is especially germane. The general conclusion was that, across nine engineering categories, there was an insufficient number of principles employed to justify a common course in electronics training. By the elimination of irrelevant electronics training, a worker can become productive earlier, and for those talented people who are ear-marked for problem solving at the supervisor level, short but highly relevant course could be provided if and when required.

PHYSICAL REQUIREMENTS

22. If there is a diminishing supply of physically qualified recruits, what actions could be taken to fill enlistment quotas with least jeopardy to operational efficiency?

23. The method requires the identification of job-types which could admit females and/or males at lower physical standards than those currently prescribed. This action releases better qualified people for more physically rigorous work. The lowering of physical standards might be considered hand-in-hand with the lowering of performance standards in recruit training. As with the previous plans, the basic task data is supplied by work supervisors at the coal face rather then by self-appointed "experts" who may be remote from the realities of physical labour in the operational field.

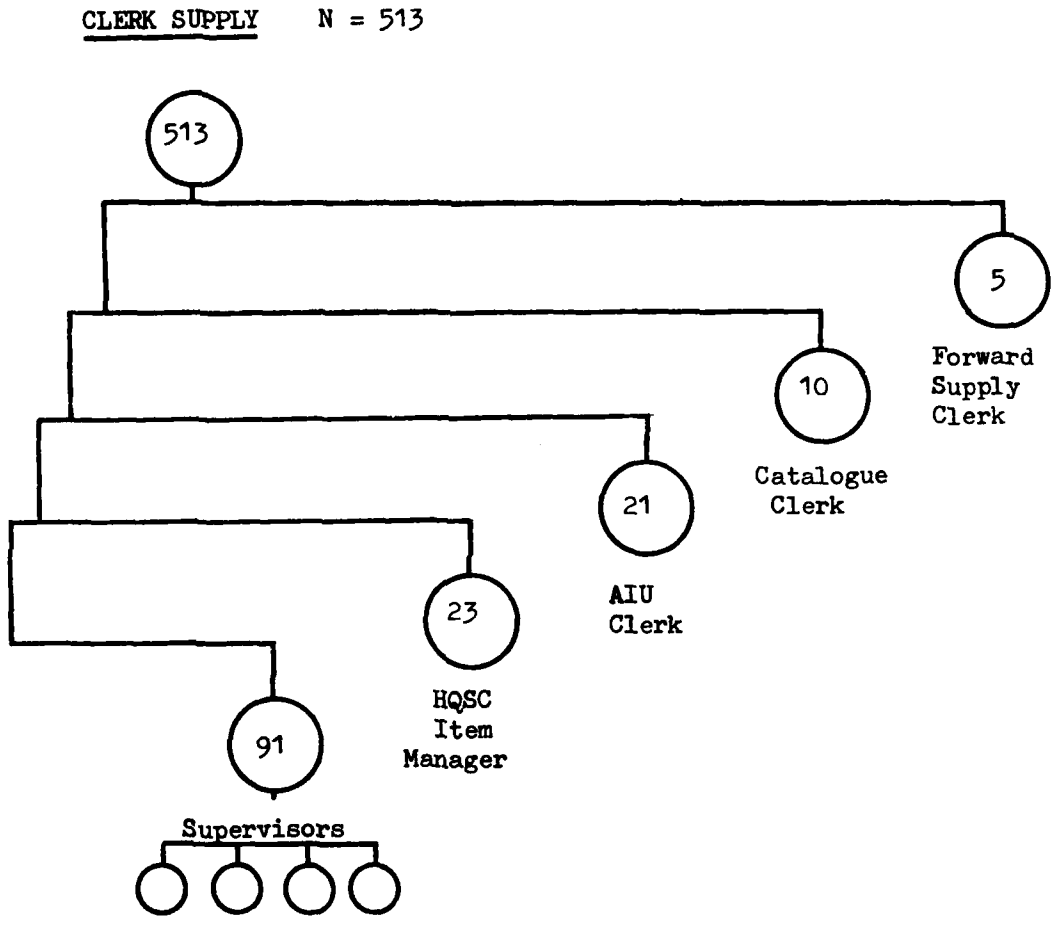
SUPERVISION

24. Given the unwanted situation of accepting personnel of lesser aptitude, education and experience, what impact would this have on supervisory standards?

25. This proposal does <u>not</u> entertain the idea of lowering job requirement standards for supervisors. Obviously, with a substantial intake of lesser qualified people, the supervisors job becomes proportionally more difficult.

26. The problem is to develop a system of career progression which will best prepare supervisors for increased supervisory responsibility. The method involves the drawing of a career path through the widest possible range of job-types with emphasis on supervisory training and experience. In peacetime, an individual's experience is often optimized by placing him in the same job-type during several successive postings. Although this makes the worker immediately useful and minimizes the need for on-the-job training, it is detrimental to individual career development and against the long-

term interests of the Service. One solution is to adopt a deliberate mis-matching policy. As an example, an encumbent who has a few easy tasks in his present job, would be posted to a job-type involving numerous tasks, including difficult and unusual tasks. In the RAAF Clerk Supply Mustering (June 1973), a Forward Supply Clerk performed an average of five tasks.



The job-type diagram shows that there are 18 other job-types, at the same rank, which would provide wider experience. The job descriptions for each of those job-types lists all the tasks that incumbents would be required to perform. A second example concerns senior supervisors. In Group 108, HQSC Item Supervisors, the incumbents perform an average 56 tasks and have one subordinate. A posting to Group 094, Supervisor, would require the incumbent to perform an average of 150 tasks and supervise 8 subordinates. Group 094 is a cluster of 160 individuals distributed into four distinct job-types.

27. This job-type mis-matching model can be illustrated further by a set of options:

a. progress from a few tasks to numerous tasks,

b. progress from an easy job-type to a difficult job-type,

c. progress to an easier job-type if evaluation reports indicate such a need,

d. progress from a few subordinates to many subordinates, or

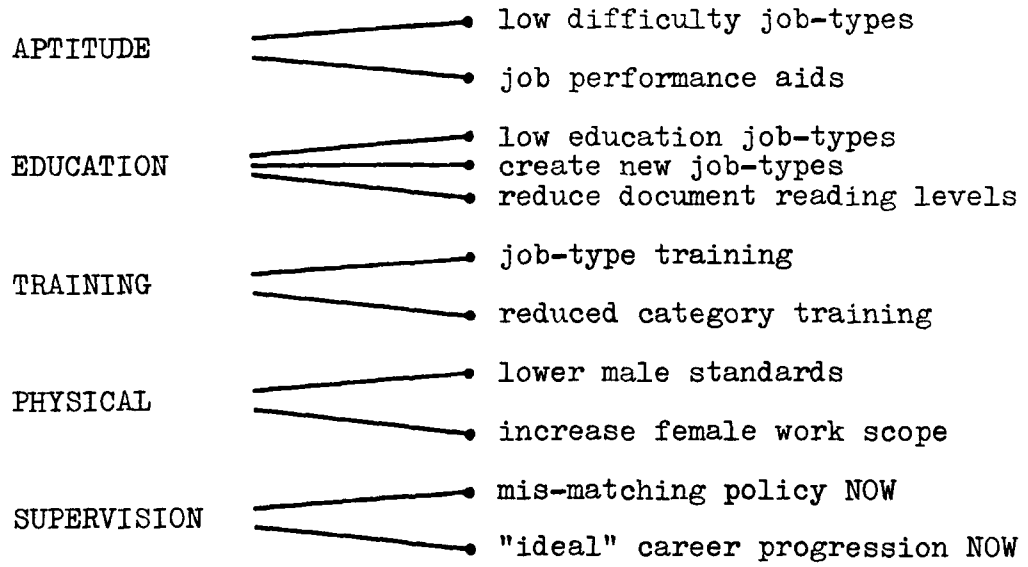
e. progress from low satisfaction to high satisfaction job-type.

28. Finally, these concepts can be meshed together to form a career progression model. This model defines the job-type path to be followed if an incumbent is to gain the widest possible experience. The model is drawn to serve the Service's best interests and may not co-incide with the individual's personal choices.

29. Although the contingency plans concerning aptitude, education, training and physical requirements may never require implementation, the plans for the "ideal" career progression to enhance experience requires peace-time application. In this sense, it is not a contingency plan, but a pre-condition for the implementation of the contingency plans.

SUMMARY

30. Possible sequential actionsto be followed are summarized as follows:



31. Finally, the practical people will want to know what resources are required for this sort of planning. If you are a specialist with the planning responsibilities for three categories, then you will need three job-type diagrams and associated job-descriptions. Usually, these printouts will be produced routinely by the analysis cells. But, in addition, the specialist may ask for task data on such factors as difficulty, reading comprehension levels, physical requirements, and electronic knowledge content.

32. As stated at the outset, this proposal has no future unless certain conditions prevail. Managers have to recognize that the contingency plan problem is worth solving, and they must persevere with long-term planning as opposed to "quick and dirty" solutions. The systematic methods proposed at this seminar can do much to make planning a "low risk" enterprise.

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CLOSING ADDRESS

Major General J.C. Hughes, DSO, MC

Ladies and Gentlemen,

1. We have come to the conclusion of the Seminar. Before closing it, however I would like to spend a few minutes summarising the main points that have emerged over the last four days.

2. First, the advantage of Data Collection and Analysis using CODAP have become clear:

   a. the information is comprehensive and is provided by on-the-job experts,

   b. the information comes from a high percentage of the job incumbents,

   c. the data is reliable, and

   d. the analysis of the data can be presented in a great variety of formats.

3. Second, CODAP has uses in a wide variety of areas:

   a. Military training,

   b. Trade testing,

   c. Rank determination,

   d. Job evaluation,

   e. Job satisfaction studies,

   f. Matching the man and the job, and

   g. Manpower planning,

to mention a few that have been discussed during this seminar.

4. Third, we have been shown a way ahead. Speaking for my own division, it is quite clear from the last session on Tuesday afternoon that my Special Studies Section has an important role to play in the coordination of occupational analysis activities of the three Services. It is also quite clear that the proposed method of Job Evaluation for "Other Ranks" jobs needs some more homework. We will consult with Dr Christal next week and the proposal will be presented again.

5. I wish to thank all those who have presented papers and contributed to the discussions. Without their efforts we would not have had a Seminar.

6. Our indebtedness to our guest speaker cannot be stated in just a few words. He has done everything possible to set us on the right course. It remains for us to make an intelligent assessment of our strengths and weaknesses and to plan carefully for the future.

7. From discussions with Dr Christal's pupils, I know that his purpose in life has been to increase the sum of human happiness. This aim is completely consistent with his private life as a family man and church leader. We can judge ourselves to be very fortunate that he chose the Military sphere in which to carry out his life's work.

8. Other countries, such as the UK, Canada and West Germany have all benefitted from Dr Christal's work, but we have received very special treatment. I hope that we can now do justice to this special treatment.

9. Would you all join with me in showing our appreciation for his efforts on our behalf over the last few days. Dr Christal.

10. Thank you Ladies and Gentlemen.

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